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Machinery for Weed Control[1]

By E. A. Hardy[2]

HOW much can weeds be controlled by machinery and how much are they controlled by the growing crop, is a question that might well be studied.

In the spring wheat areas of northwestern United States and western Canada such weeds as wild oats, mustard, quack grass, sow thistle, Canada thistle, Russian thistle and French or stink weed are constantly on the increase, in spite of the use of machinery and the controlling effect of the growing crops.

The loss of crop moisture and soil fertility, as well as the increased cost of harvesting and marketing the weeds with the grain mounts into hundreds of millions of dollars annually. Such a loss is not in keeping with the times. The increased cost of production, due to weed growth, often is responsible for a loss in the business of farming rather than a profit.

Weeds must be controlled or they will control the farming in the spring wheat areas. If we will be honest and admit the facts, the weeds are well in control at the present time.

There are two sources from which weed seeds come. One is from the seed sown into the land, and the other is from the crops of previous years. A seed drill survey made in Saskatchewan in 1927 by the field crops branch of the department of agriculture, indicated that there were seventy-five noxious weeds sown per acre. Samples of seed were taken from the seed drills of over 900 farmers representative of all parts of the province. The samples were analyzed and graded by the dominion seed branch on the basis of weed seed content. It was discovered that 70 per cent of the Saskatchewan farmers were sowing wheat containing noxious weed seeds sufficiently to make the seed unfit for sowing.

A study was made from 753 samples of seed wheat which had been cleaned with thirty different makes of seed-cleaning machinery. It was not possible to make any comparisons between the cleaning machines from the data. Such factors as the human element and the pollution of the original stock more than outweighed the type of cleaning machine used.

The majority of grain farmers used seed cleaning machinery of some kind more or less efficiently. There is a great deal of extension work necessary to develop in the individual farmer the desire to clean all of his seed grain efficiently. There is also a great need for the development of a fairly large capacity and yet efficient and inexpensive seed cleaning machine, which will be capable of cleaning all seed grain efficiently. Such cleaning machinery would, of necessity, be equipped with extra sieves, screens or drums, so that all grains could be handled correctly. The overhead resulting from the purchase of special seed cleaning equipment for each grain is prohibitive for the average farm.

Seed grain cleaning machinery holds an important place in the equipment for weed control.

It is extremely important that the grain sold on the market be as free from dockage as possible. Grain cleaning machinery on threshing machines and combines have been developed and if operated intelligently reduce the loss from dockage considerably. Recleaners should be used for the coarse grains, as well as for wheat, if the spread of weed seeds through the market grain is to be reduced. The enormous loss due to dockage can be reduced by the use of grain cleaning equipment on all threshing machines and combines.

The weed seeds which are in the soil from previous crops will be controlled by machines and methods varying with the weeds in question.

Wild oats are probably the most prevalent and most difficult to control of all noxious weeds. They must not be sown with the seed. They should not be spread by racks, wagons and threshing equipment. They should be ground thoroughly when fed to livestock and all manure should be rotted before being spread over the land.

Wild oats already in the soil may be controlled or destroyed by tillage machinery. Where a crop is to be grown, the wild oats should be disked in the fall and packed, if

[1]Paper presented at the Power and Machinery Division session of the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June 1931.

[2]Professor of agricultural engineering, University of Saskatchewan, Saskatoon, Sask. Mem. A.S.A.E.

(Left) A shallow deadfurrow in which all the weeds have been cut. (Right) A level backfurrow with all weeds cut and covered

(Left) A typical case of soil drifting from plowed summer fallows. (Right) Disk harrowing, seeding and packing at one operation

possible. The disking should be shallow, but complete, so that all of the wild oats will be covered and in contact with soil, so that early spring growth will be stimulated.

The wild oats should be plowed shallow late in the spring, after they have attained a height of from two to four inches. All weeds must be cut and turned under. If time does not permit of plowing, the wild oats should be cultivated with the duckfoot cultivator once, shortly after the wild oats have emerged and later just before seeding. Immediately after the last cultivation or plowing, barley or oats should be seeded. Barley is better adapted for this purpose than oats because of its more rapid growth. Oats may be sown if required for green feed. They should be cut soon after the wild oats are headed or the wild oat seeds will be viable.

Fall rye may be used in districts suitable to its growth. In many cases it matures and is harvested before the wild oats have developed sufficiently to produce seed which will grow.

The burning of combine stubble will destroy a considerable portion of wild oats seeds which are exposed on the ground, provided that the soil surface is dry and a good burn is secured.

Any cropping system containing a hay or pasture crop is very effective in controlling wild oats, if the crop is cut for hay or pastured so as to prevent maturity of the wild oats seeds. The control of wild oats is much easier when the farming system includes cattle or sheep.

The machinery used in the control of wild oats are important. The disks used in the fall must be sharp and in good condition in order to do complete shallow disking. The plow, which is mostly the moldboard plow, must be sharp and in proper adjustment in order to completely cut and cover all of the wild oats preventing further growth. The coulters should be fitted with jointers which assist in covering all of the wild oats and short weeds.

The methods of laying out lands and finishing both the deadfurrows and headlands are of particular importance. The only effective method of forming a backfurrow which will cut all of the weeds and cover them as well as leaving a smooth level backfurrow, is to take one extra round to form a shallow deadfurrow in the center of the proposed backfurrow.

The shallow deadfurrow cuts all weeds and provides a place for a low flat backfurrow when on the second round the backfurrow is formed by plowing a little deeper and gathering all of the weeds and stubble cut into the center. The wide open backfurrow, where from 18 to 24 inches of uncut weeds are left, is the greatest menace to weed control of any in the use of the plow. Wild oats, as well as many other weeds, must all be cut and covered so that there is no opportunity for further growth.

The finish of a land which is just the width of the rear bottom and only slightly deeper than the average depth of plowing is much more desirable than the shallow wide finish. The narrow finish can be filled with tillage machinery so that the deadfurrow is not objectionable to work through, and can be kept free from weeds by the use of the ordinary tillage implements.

The headlands and the two side lands of the field should be left until last, so that when the field is finished the headlands and side lands are plowed by throwing the land in against the plowing as the outfit travels around the field.

If the land is being summer fallowed the use of the duckfoot cultivator and rod weeder at intervals to keep the soil free from weed growth is desirable. Where other weeds are to be controlled as well as wild oats, it is essential to keep the summer fallow black throughout the rest of the growing season. In many areas the tillage machines used must be studied carefully, so that the land will not be pulverized enough to cause soil drifting. Soil drifting is very serious in Saskatchewan and Alberta.

The practice of burning stubble for the control of wild oats has persisted for years in many districts. There is no doubt that all oats not protected by the moist soil will be destroyed by a good burn. However, the stubble is very necessary in the soil as a binder to prevent soil drifting. The excessive soil drifting is, in many cases, brought about partly by stubble burning and the use of tillage implements which pulverize the soil excessively.

The mechanical stubble burners using straw or oil as fuel, have never been economical to operate. The first cost has been high and the cost of operation too high for the results obtained. The results of tests made at the dominion experimental station at Swift Current, Saskatchewan, would not indicate that the investment in a stubble burner and its use was profitable.

The Committee on Weed Control at the annual convention of Saskatchewan agronomists recommended the methods of weed control herein outlined, with the exception of quack grass.

It is practically impossible to clean out wild mustard from land by cultural or crop rotation, since the seeds remain viable in the soil for many years. Only a small percentage grow from year to year, thus leaving sufficient seed for plants to mature and furnish an increase from year to year.

The growth of wild mustard is hampered by the competition of the growing crop. The land must be free from seedlings when the grain is seeded. Thus, the grain has an even chance with the weeds to hold them back and prevent too free a growth. In order to do this, it is necessary to precede the drill with either the cultivator or disk, or to use combination seeding tillage machinery.

Seeding down to hay or pasture crops for three or four years does not result in the eradication of wild mustard, since the seed can survive for many years in the soil. The use of commercial fertilizer has proven beneficial, due to the stimulation in the early growth of the grain, thus handicapping the weed.

Wild mustard can be killed when in a crop of wheat, oats, or barley without injuring the grain by spraying with

chemicals. The wild mustard must be sprayed while the weeds are young and the crop plants have about four leaves. In 1930 where large numbers of mustard plants were present, the yield of grain was increased by spraying. Several chemicals were found satisfactory, the most promising being sulphuric acid, copper sulphate and copper nitrate. Further experimental work is required before any of these can be recommended.

The use of machinery in controlling wild mustard is obvious. Shallow tillage with the disk in the fall is desirable to cover the wild mustard, in order that early germination be stimulated. Where spring plowing is done, the plowing should be delayed to provide time for as much germination as possible. Where seeding is on summer fallow the use of the disk harrow or cultivator is delayed to the time of seeding. It is necessary to have sufficient power and equipment to complete the tillage and seeding as nearly at the same time as possible.

The nature of the soil and the tendency toward soil drifting will govern to a considerable extent the tillage implement which should be used. In much of the clay soil the single disk harrow brings up moist clay in lumps, so that soil drifting is stopped and a crop of wild mustard is killed. Some of the clay soil which is mixed with a sandy loam tends to blow and drift more when disked, consequently the cultivator is used. The great difficulty in using the cultivator is the fact that the shovels do not scour in the clay and clay loam soils, resulting in excessively deep tillage of rather poor quality. The spring tooth harrow is often fitted with narrow shovels and used to till the soil previous to seeding, in order that a crop of wild mustard may be killed before seeding.

There have been a number of combination tillage and seeding machines used for conditions where it is desirable to till the soil and seed at the same time. The one-way disk with the seeder box is about the only machine which may be used in the clay and clay loam soils during dry springs. The machine is not satisfactory in a wet spring, because of the weight of the machine over the soft clay soil and the tendency to clog.

The light spike tooth harrow is used to harrow the crop after seeding and often after the grain is up to destroy a second crop of fine wild mustard. In cases of severe soil drifting, it is not wise to harrow after seeding. The spike tooth harrow is more efficient when light and sharp. Probably the most weed killing for the least expense is done with the harrow.

Quack grass is one of the most persistent of weeds. It not only spreads and grows from underground running roots, but also seeds quite heavily. Quack grass should never be allowed to go to seed. It should be mowed when used for hay, early enough to prevent seeding. Where quack grass is thick enough to form a complete sod, it is desirable to use it for a year or so as a hay crop or pasture. If pasture, it must be kept short so that it will not seed.

As soon as quack grass is noticed in patches in a field, the patches should be worked separately. Tillage machinery has largely been responsible for dragging quack grass roots over a field and spreading the grass, instead of eradicating it. The spring tooth harrow is a satisfactory implement for patch control. The patches should be summer fallowed and the grass worked out of the soil. Neglect is responsible for a great deal of quack grass infestation.

Quack grass should be plowed with either the moldboard or disk plow in the fall, so that the frost may act upon the soil so that either the spring tooth harrow or spring tooth cultivator will work on the land without clogging with the sods. The roots and plants should not be buried deeply when plowing. The grass should be plowed just below the root systems. The land must be harrowed until the root systems are dragged out of the soil and dried in the sun and air. In the western plains where the rainfall is not high, it is usually not necessary to gather the roots and burn them. The harrowing should be done during dry weather. It is altogether a waste of time and energy to work on quack grass land during wet weather. Sufficient equipment and power should be had to go over the land being cleaned in one or two days. Thus, the great advantage of dry hot days may be realized in killing the root systems.

Where it is not possible to fall plow, shallow spring plowing may be done. The plowing often needs to be disked with a dull disk which will not cut up the sods, but which will loosen the soil in the root systems so that the spring tooth cultivator or harrow will not clog excessively with sods.

It is sometimes advisable to plow the second time, so that fresh root systems may be exposed. It is necessary to plow after a wet spell. The plow is a most effective implement to kill quack grass. The land must be worked so that all of the root systems and plants are removed from the land and all growth above the ground prevented for one year, and the quack grass will be eradicated.

The machinery used in the eradication of quack grass is the plow, the spring tooth harrow and at times the stiff-shank, duck-foot cultivator. When the disk plow is used the setting of the scrapers and the hitch should be carefully adjusted, so that the grass will be covered and the root systems exposed. A special effort to operate the disk plow at a shallow depth should be made when plowing quack grass.

The spring tooth harrow or cultivator which is used most successfully on quack grass has long curving pointed spring teeth that are perfectly smooth, so that the quack grass roots will slide well up the tooth and then trail out behind. Where the curve of the teeth is more abrupt in design, the root systems do not trail out on top, but break off in the soil.

A field which has become badly infested with perennial sow or Canada thistle can only be cleaned up by the use of the "black summer fallow." To obtain a "black summer fallow" the land is first thoroughly plowed, and then sur-

(Left) The seeder-plow gives best results when used in light soil. (Right) Seeder-plow with packer trailing

face-cultivated frequently enough to absolutely prevent any green growth. It may be necessary to cultivate once each week during the earlier part of the season and less frequently later.

In cases where it is desired to grow crops and reduce the perennial sow and Canada thistle infestation, perennial sow thistle can be set back and its growth retarded severely by plowing four inches deep immediately after the grain is cut. The plowing should be disked or cultivated during the fall months to prevent young shoots from appearing.

Canada thistle should be mowed when in bud or early flower, a second mowing is often required. The land should then be plowed five or six inches deep late in the fall and the furrow slice left exposed to the winter frost.

Perennial sow and Canada thistle can be eradicated by the use of sodium chlorate sprayed on the weeds. Any commercial weed killer containing chlorate is effective against the weeds. Perennial sow thistle may be effectively retarded by pasturing with sheep and plowing four inches deep after harvest. The close pasturing by the sheep materially reduces the vigor of the roots, so that plowing severely sets them back.

The control and eradication of perennial sow thistle and Canada thistle is a power and machinery proposition.

When using the plow it is particularly important to do thorough plowing. Where the backfurrow is not cut out clean, the thistle flourishes, infesting the remainder of the field. Also where deadfurrows are left, which cannot be filled or worked through with tillage machinery, thistle grows rapidly and causes serious infestation.

The duckfoot cultivator is used a great deal as a surface-tillage implement, but is not operated efficiently because of the difficulty in scouring and retaining a reasonably sharp edge. The crucible steel used in the manufacture of duckfoot shovels will not take a land polish required to scour for surface work in clay loam and clay soils. The quality of the shovel should be improved to increase the efficiency of the shovels and the cultivator.

The rotary rod and wire weeders are used because of the inefficiency of the cultivator. The weeders are used to remove tap root weeds and do so very effectively. The draft of the implements is heavy, and the maintenance high, where the land is stony and irregular. The land must be firm and yet not soddy for the weeders to do best work.

The weeders are often used either before the drill or after seeding some two or three days, in order to kill a crop of small weeds.

Russian thistles are more serious on light land and in dry districts. They cannot compete with a good stand of grain and are not serious during wet years when the growth of the crop is normal. However, when the moisture is limited and the growth of the crop is slow the Russian thistles thrive and rob the crop of the small amount of available moisture.

When preparing stubble land for crop, the thistle and trash should be burned and the land plowed not over four inches deep, harrowed and seeded immediately. Combination tillage and seeding machinery are quite successfully used in combatting Russian thistles.

The plow-drill combination which plows, packs, drills and packs in one operation is very effective in producing rapid germination and quick early growth, thus giving the crop the much needed advantage to control the Russian thistles.

The seeder plow is designed to plow a 42-inch strip with six 7-inch plow bottoms and broadcast seed into the furrow bottoms ahead of the moldboards. Thus the grain is placed in contact with the moist ground which causes rapid germination and growth. The use of a packer assists the germination and pulverizes the soil which reduces evaporation and tends to stimulate rapid growth.

The seeder plow is a four-horse load, so when the packer is added, it is best to use five horses for plenty of power. The seeder plow has given difficulty in scouring when used in clay loam soils, due to the shallow tillage; also it has had no protection against stone and has been bent and broken badly. The machines have been drawn in tandem by a tractor using a wire drawbar which would break if the plows come into contact with solid stones.

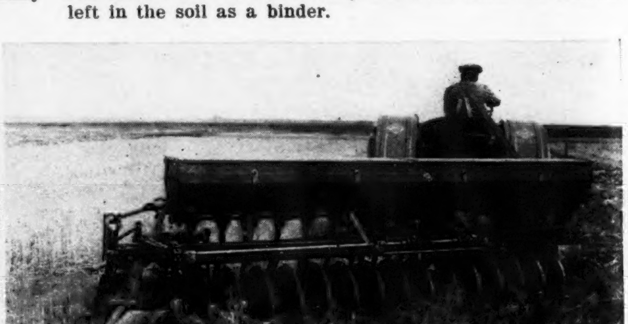
The subseeder is also a combination machine which uses a wide duckfoot shovel as a furrow opener on the grain drill. The furrow openers are spaced 12 inches apart on centers. The grain is delivered to the rear of the shovel and broadcast forward under the shovel placing the seed on the moist soil ready for early germination. The first crop of Russian thistles are killed, the stubble is on top to prevent soil drifting and the grain is seeded in the one operation.

The subseeder pulls approximately one-third heavier than the disk drill of the same size. The shovels scour with difficulty in clay loam soils and cannot be used in clay soils. Their pressure springs are not flexible enough to operate the shovels at a uniform depth on irregular land without altering the hand adjustment. Consequently, for large-scale tractor operation the subseeder is not satisfactory. It, however, has considerable merit where the soil is light and the district is very dry.

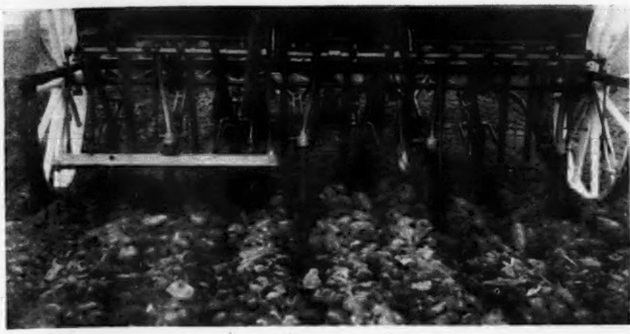
The one-way disk and seeder already discussed is frequently used to destroy a crop of Russian thistles and place the grain in the most soil in order to hasten and stimulate germination and grain growth.

On summer fallow where Russian thistles are the greatest menace, the grain is seeded early in order to get the crop established earlier than the weeds. However, where wild oats and stink weed are also present, the plan of delaying slightly and then disking or cultivating when seeding is much preferable. It is not wise to delay too long or poor germination results from lack of moisture. In all seeding operations care must be taken not to leave unseeded strips through the field. Such spaces will always fill up with Russian thistles.

Land infested with Russian thistles may be given a light stroke with the disk in the spring to stimulate growth, then plowed shallow, or one-way disked, or cultivated and rod weeded, frequently enough so that a crop of Russian thistles is killed at each cultivation. The light soil often blows or drifts badly and must have the stubble left in the soil as a binder.



(Left) Harrowing with spring-tooth harrow previous to seeding. (Right) One-way disks equipped with seeder attachment



(Left) A subseeder cultivating and seeding in one operation. (Right) Disking with the one-way disk harrow. Note stubble in soil

The use of the one-way disk is increasing in the prairies because of the drought and the soil drifting, in spite of the danger of saw-fly damage to the wheat, where the combine is used for harvesting. The one-way disk cuts and pulverizes the soil, so that weeds are exposed to the sun and air and yet the stubble is not buried, but is available for holding the soil.

The rod weeders are good to use where the cultivator has been unable to cut all of the tap-rooted Russian thistles. The weeders will pull the thistles and leave them exposed to the sun.

Stink weed is very difficult to eradicate by cultural or crop rotation methods. The seeds remain in the soil for many years. Each year sufficient germinate and grow to infest the whole area. The general method of control is to retard the weed growth in the spring so that the grain crop will have the advantage. Stink weed cannot compete successfully with a vigorously growing crop. It is common to produce a good grain crop no matter how much stink weed seed there is in the soil.

The field must be free from stink weed seedlings when the grain is being seeded. It is necessary to cultivate or rod weed and sometimes both, to free the soil from the stink weed seedlings. It is often desirable to trail a packer behind the drill to pack the loose soil over the seed to stimulate germination of the grain and hasten the growth. The grain must make a rapid, strong growth in order to dominate over and smother out the stink weed. Commercial fertilizers have been beneficial in the control of stink weed by stimulating the early growth of the grain crop.

Chemical treatment has proven successful in an experimental way by spraying stink weed with sulphuric acid, copper sulphate or copper nitrate. More experimental evidence is necessary before the chemical method of control can be recommended.

Seeding down for three or four years to a hay or pasture crop does not eradicate stink weed. Stink weed is very bad in a pasture as it taints the milk.

Plenty of power and implements are necessary to go over the fields in a minimum of time, so that the stink weeds can be killed, immediately before seeding and in many instances, three or four days after seeding.

An enormous amount of power is required to adequately control the weeds of the spring wheat area. The efficiency of the machines as to power requirement, as well as the quality of the work, presents an economic problem which cannot be neglected.

A study of machinery for weed control indicates that several machines of special designs are desirable, that all machines should be sharp and in good adjustment, and that great consideration must be given to the problem of soil drifting as well as weed control when considering the machine to use, the timeliness of its use, and the quality of the work.

1731 — 1831 — 1931[1]

FOR some peculiar reason, in comparisons of present day life with that of preceding times, it seems to be assumed that progress invariably moves only in one direction. This, of course, is not necessarily true. We see this easily if we review the history of the primary factor underlying the industrial changes of the twentieth century and the two centuries which preceded it.

That primary factor is power. Our life today—with its machinery, its mass production and its teeming cities—is an outgrowth of changes in the nature of our power resources. The life which it supplanted—the rural life—likewise was determined by the nature of the power resources of the time.

* * *

The year 1731 was one in which population was widely diffused. Why? Because it was necessary to derive from agriculture the greater amount of the energy necessary to do the world's work; and agriculture is necessarily a scattered activity. Furthermore, without mechanical power there was little incentive to develop machinery or organize people into factories.

Violent changes occurred in the following hundred years. Freed from the definite limitations of human energy, and with the infinite resources of the coal pit at its command instead of the meager annual crops, industrial production multiplied. To take advantage of this greater energy supply, it was necessary to concentrate production, because the power supply itself was concentrated. Great cities drew population from the countryside. The countryside could spare them, because agriculture no longer had to produce the entire energy supply, and because agriculture itself simultaneously became more efficient.

* * *

These changes, too, are concerned with the nature of our energy supply. Power changed the decentralized industry of 1731 into a centralized industry by 1831. In 1931 power appears to be changing industry back into a decentralized structure. The power supply of today is widely distributed. Electricity is available in any quantity at virtually every point on the map—whereas its predecessor, steam power—was to be had at relatively few points. The same is true of transportation—which is, after all, another form of power. And industry is not slow to recognize the advantages of decentralization, in terms of power costs and improved working conditions. . . . . We need not necessarily expect still more congested cities, still higher skyscrapers and a depopulated countryside. The industry of the future is more likely to re-inhabit the countryside; to possess all the advantages of power machinery without the disadvantages of congestion which have hitherto accompanied it.

[1]From a contribution by Martin J. Insull, in "Research Narratives" Vol. 11, No. 9 (Sept. 1, 1931).

Farm Structures Work in the New Federal Bureau of Agricultural Engineering[1]

By S. H. McCrory[2]

MUCH progress has been made the past year in creating interest in farm structures research, during which time Mr. Henry Giese completed the survey of research in farm structures, which he conducted for the U. S. Department of Agriculture, and submitted a report thereon, which is now being printed and should soon be available for distribution. Mr. Giese's activities did much to stimulate interest in farm structures research. It also made clear the desirability of a carefully correlated program if available resources were to yield a maximum return.

Last fall President Hoover called a conference on home building and home ownership. This conference has for its object a broad inquiry into the problems of housing. The planning committee has organized 25 committees to study the various phases of the problem, and one of these committees has been given the job of making a study of farm and village housing. This work is now being organized under the direction of Dean A. R. Mann of Cornell University. Arrangements have been made for Dr. Bruce L. Melvin to act as executive secretary. While this committee is not a research agency, its activities should do much to create interest in bettering farm and village housing and to bring forcibly before the public the needs for investigation and research in this important field. The work of the conference should supplement and broaden the interest created by Mr. Giese's survey.

The establishment of the Bureau of Agricultural Engineering (U.S.D.A.) has given us an opportunity to adjust our work dealing with farm structures; the program for the Division of Farm Structures thereof has not been an easy one to formulate. In recent years we have had to handle an increasing amount of work involving the preparation of plans and specifications for structures needed by the Department. At times this work has interfered seriously with our research work. In order that the research work relating to farm structures may proceed unhampered, it is planned to divide the work into two units, the one dealing with research and the other with service.

We now have three projects dealing with farm structures in progress. The first is a study of farm storage on corn belt farms, on which project the field work is completed and the report is nearly completed. The second project deals with the heating of greenhouses, and the report is nearly ready for the printer. The third project in progress is a study of the housing of dairy cattle and the effect of housing on the animal. This is a cooperative project between the University of Wisconsin, the bureaus of dairy industry, agricultural engineering, and public roads of the U. S. Department of Agriculture, and Mr. Howard Green, owner of the dairy farm where the studies are being made. It involves the cooperation of a group of scientists and engineers and is the direct outcome of Mr. Giese's survey.

The program of research that will be undertaken by the division of farm structures research of the Bureau of Agricultural Engineering, has not been fully developed, as it seemed inadvisable to proceed with the formulation of a plan until the head of the unit was selected. In general, the program of research will proceed along the lines suggested in Mr. Giese's report. In addition to the work in progress the following projects will be undertaken as rapidly as possible: (1) Studies of the problems involved in modernizing farm homes; (2) storage of potatoes, and (3) sterilization of greenhouses and the soil in the houses. It is possible that later in the year our facilities will permit us to undertake another project.

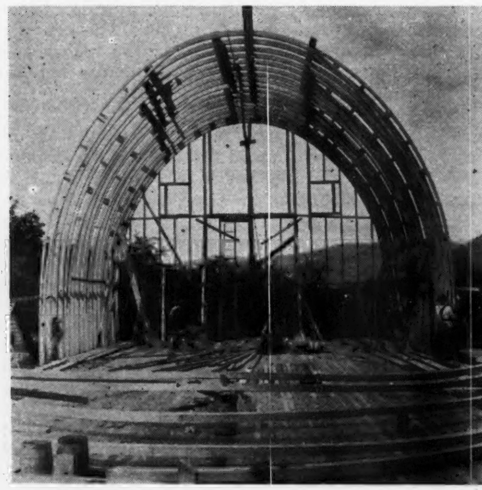
It will be our policy to extend all possible assistance to groups engaged in the development of plans suited to a given region.

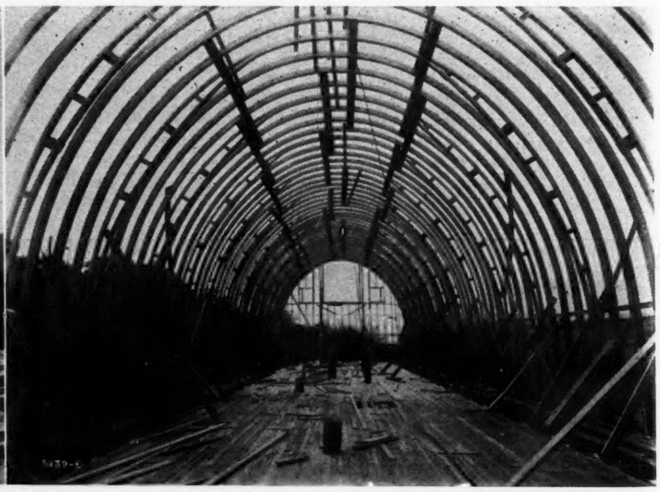
It will be our policy to establish cooperative relations on every project where opportunity for cooperation is offered and mutually satisfactory relationships can be established.

In my opinion, there is a great opportunity for constructive work in farm structures research, and, if the interest in this work continues to develop as it has recently, it will soon be commanding the support that its importance to American agriculture warrants.

[1]As reported at the Structures Division session during the 25th annual meeting of the American Society of Agricultural Engineers at Ames, Iowa, June 1931.

[2]Chief, Bureau of Agricultural Engineering, U. S. Department of Agriculture. Mem. A.S.A.E.





Gothic roof framing. Method developed as a result of research. Note the trussed elements

Harvesting Small Grains by Binding and Heading

By V. Rosam[1]

THIS method of harvesting differs from the usual by cutting the stalks into two parts, a short head part and a long basal part. It is accomplished with a sheaf-binder bearing before its binding apparatus a specially arranged cutting device. The heads and loose grain are collected into small exchangeable wagonettes hauled by the binder. When filled they are either reloaded into carts or a series of such wagonettes are connected to a train and hauled away. They go either to the threshing machine, or the heads are put into cribs made of wire, to dry out and condition.

The straw leaves the self-binder in sheaves which are gathered into small shocks, where they are left until they are thoroughly dry and can be stored in a shed or built into a great stack.

Behind the binder is drawn, in the same operation, either a spring-tooth cultivator or a disk harrow provided with a drill box for sowing and burying mixed seed for fodder, silage or for green manure. Behind the cultivator is drawn a roller to make the seed germinate as soon as possible.

This manner of harvesting offers the advantage of first removing from the field only the grain-heads—about one-third of the whole crop weight—the straw being left for handling at a later time. The effect is a reduction of the peak load of harvesting. Furthermore, all shattered grain is collected and there is no afterrake to be done, making it possible to loosen the soil surface and re-sow it in the same operation.

The weed seeds, which spread during the growth of the cultivated crop, are brought to germination by this cultivation and re-seeding and can easily be destroyed; also the capillarity of the soil can be broken up and a premature drying of the arable ground avoided. At the same time the soil bacteria are kept in continuous activity.

Besides the above mentioned factors, the fact should be pointed out especially that the heads separated from the stalks are immediately cleared from the field and carried under roof where they are protected from unfavorable weather. The roofed spaces which generally would not suffice for storing the whole crop with straw suffice in any case for securing the heads.

For threshing the heads are easily and quickly blown by a fan to the cylinder. The work can be done with a small number of workers and the efficiency of fuel increases, while its consumption decreases.

This method of harvesting aids in producing high-quality grain, preserving a vivid color in wheat, and preventing barley from becoming yellow, speckled and sprouted. Furthermore, the harvested grain cannot be stolen from the field, as only straw remains there.

A mixed crop for silage is sown in Czechoslovakia after the chief crop, even when that was barley or wheat. The greater probability of getting from at least a part of the land a double harvest within one year has been mentioned. This helps to obtain a considerably greater quantity of forage. At the same time the fertility of the soil is raised by the summer tillage, its enrichment being not only in

[1]Director of the Institute for the Economy of Labor in Agriculture, Uhrineves, Czechoslovakia.

(Upper left) A close-up view of the heading knife which heads the grain for threshing, leaving only the straw to be bound. (Upper right) Using the binder with heading attachment followed by spring-tooth cultivator, seeder and roller, all drawn by one tractor. (Lower left) Elevating a wagon load of grain heads into a crib with an endless belt type of elevator. (Lower right) Blowing grain heads into a thresher

stubble and roots but also from the stimulation of micro-organic plant life in the soil. This method of harvesting makes it possible to increase the number of cattle kept on a given farm and to intensify the whole management of the farm.

Even a crop laid down heavily can be harvested in this manner if the grain falls regularly and does not spread over the whole canvas.

American combine harvesters are with only a few exceptions not suitable for Czechoslovakian conditions because of high first cost, cost of operation, waste of straw, and failure to give some of the other advantages enumerated above.

It is understood that world competition can be met only by those who are able to produce at low cost and to supply the market with products of best quality. When, after all the trouble of a whole year, a farmer finally goes to harvest, bringing in his grain and turning it to account is an urgent problem. Any possible improvement of the harvest work is highly important for him.

Institutions for Agricultural Production

By David Weeks[1]

THERE has been much activity in the creation of marketing institutions in recent years. There is still much opportunity for constructive work in this direction. Institutions devoted to production economy and rural social betterment, however, have been almost completely neglected. It is this phase of rural improvement which is badly in need of institutions for harnessing the potentialities of recent inventions. Much has been written recently regarding the industrialization of agriculture. Nothing new, however, in the way of institutional machinery has been suggested. The idea of the corporation as a means of reaching that last stage of perfection in the "new agriculture," is as old as the industrial revolution. What needs to be done is more fundamental.

At present, tenure of farm land by corporations is not extensive. There has, however, been some increase in recent years. The extent to which there will be consolidation of farms into large farming enterprises is still a question to which the answer is complicated by many important considerations. The conscious shaping of our destinies by planning our rural improvement is difficult, but it has great possibilities. The establishment of more efficient local rural government units would seem to be a step in the direction of service and economy. Machinery which will make possible the progressive work of the majority in spite of forceful opposition by obstinate minorities is essential for rural progress.

If the corporation is to become the dominant institution in agricultural production, there are many important questions to be answered. What type of corporation will most adequately serve in the new agriculture? Is there a possibility of corporate operation of some of the major agricultural production functions without land tenure? Can we maintain existing farmsteads for certain phases of intensive agriculture in combination with large units of land for large-scale production? What are the financial problems in connection with corporate operation and ownership of land? Will local industries solve the employment problem for those displaced by the efficiency of the new agriculture? What part will federal and state governments take in the development of agricultural institutions in the future?

PRODUCTION ECONOMICS VERSUS POLITICAL ECONOMY

The answer to most of these questions will require the orientation of economic study and analysis to some of the problems of production. There is likely to be in the future less of political economy and more of production economics. There are large numbers of able agricultural economists ready to undertake some of the most difficult parts of the new program. The "new agriculture" cannot develop without growing pains. The diagnosis of the causes of these growing pains can best be carried out by the economists. Diagnosis without a remedy, however, is worse than no diagnosis. Institutions, largely non-governmental, for accomplishing the evolution without revolution, are no doubt the remedy.

Large-scale farming operations in the past have been unsuccessful due to shortage of capital in proportion to the amount of land, and to inadequate management of land and capital. Probably the most important reason why smaller farms (within certain limits) have paid better than larger ones is because every farm produces an income made up of cash and of intangible elements. These intangible factors of income ordinarily disappear under large-scale agriculture. They constitute a large part of the family living of the farmer. They are found in the aesthetic or psychic values of rural life, and such elements as satisfaction in land ownership.

In the "new agriculture" we must take into consideration these intangible elements of farm income. A very important part in our agricultural production can best be carried out on small acreages. The automobile should make possible the preservation of the best of our present farmsteads with small acreages for the production of intensive crops.

Additional employment provided in the way of industries may be fostered by careful investigation of the industries which may best thrive under decentralized conditions. It must be remembered that definite reasons exist for the centralization of manufacturing industries. There are, however, certain processes which can be carried out in connection with agriculture by the utilization of the manpower which is to be made available by the growing efficiency.

PLANNED RURAL IMPROVEMENT

The planning of the rural community with its coordination of activities, the proper adjustment of large-scale and small-scale farming, the utilization of surplus labor, and provision of modern facilities which facilitate a higher plane of living requires the coordinated effort of the agricultural engineer and the economist. That our progress may be permanent, our development should be planned. The inauguration of a system of farming that will not endure is likely to come from lack of foresight. The new efficiency must be great enough to overcome the effect of possible over-supply of labor. The new efficiency must, as it has not done during the past twenty-five years, increase acre efficiency as well as man efficiency. In the next few decades, there will be a race between machines and labor. The domination of the former means domination by large-scale farming. If labor is able to outbid machinery, then small-scale proprietorship farming will continue, as it is as present, to be the dominating system.

In any event, the system of farming which will mean the greatest social advance should be the goal. This determined, the institutions which will bring it about with the least amount of waste should be the subject of intensive study. This study will require the bringing together of legal, business, engineering and economic thought. There are men of high calibre in each of these professions cap-

[1]Division of agricultural economics, University of California.

able of working on the different important phases of the problem. The American Society of Agricultural Engineers and the American Farm Economic Association should appoint a joint committee for the study of these important questions, and for the purpose of coordinating national research along these lines. Such research should include study in minute detail in cooperation with farm management experts, of the possibilities of further division of labor in agriculture, and the development of new devices for cutting down the time of performing each step in the production process. Studies should also be made of the most advantageous combinations of enterprises. The planning of rural communities, the feasibility of organizing rural improvement districts, the nature of corporations which may function in the general plan, and the problem of utilizing the surplus labor of the rural community resulting from increased efficiency, together with possible local industries, including the processing of agricultural commodities, demand detailed and careful investigation.

It is somewhat idealistic, but nevertheless worth while to imagine our present rural homes surrounded by small areas of intensively cultivated crops, beautified by landscape design, with the major part of the field crop land combined into enormous enterprises for efficient production.

THE CORPORATION OPERATING WITHOUT LAND TENURE

There are a number of ways in which corporations could farm without owning their land. If the owner of a farm could obtain a higher income by farming intensively a small part of his farm and renting the balance for an annual cash rental, it would not take him long to adopt that procedure. If a large corporation, formed for the express purpose of farming large acreages of rented land, could be organized in such a way that it could pay the farmer a larger return annually for his land than he now receives and at the same time make profits for the corporation, it would not take long for many such corporations to come into existence.

RURAL IMPROVEMENT DISTRICTS

Where there are bodies of land owned by persons opposed to reorganization the remedy might be found in the formation of rural improvement districts. The rural improvement district, however, could be utilized for more purposes than merely securing large contiguous bodies of land for economic purposes. Human relationships in the country should be made more secure by the development of more unified rural and local governments. These local rural governments would constitute legitimate competing units, vying with other rural communities in local development, promoting the best interest of their citizens, furthering educational facilities and making possible the employment of experts on matters of local importance.

Just as municipalities through their different organizations make it attractive for manufacturing industries to establish themselves within their limits, the rural improvement districts might be able to foster the development of industries within reach, by automobile, of the rural homes. The farm family would thus be supported (1) by the products yielding to intensive agriculture on small acreages; (2) by a share in the annual income from general crop land operated by a corporation; and (3) from supplemental income derived from wages earned in local industries. The basis of forming the corporation would depend entirely upon local circumstances and upon established practice after investigation and experience had indicated that such an organization would be the most adaptable. The best form of organization can only be determined by research and experience. We cannot say positively that the rural improvement district is the proper institution for accomplishing this end, without more detailed investigation than has been made so far.

The corporation could be a mutual company or a public utility. The stock in the corporation might be held entirely by the owners of the land, the value of the stock of each individual being determined by the appraisal of the land included or by annual returns. Upon the basis of this stock as security, bonds could be issued for the industrialization of the plant. Stock, as well as directors, might or might not be limited to land owners. Income could be prorated according to the returns per farm or according to the shares owned in the operating company. It might be in the form of dividends on stock or from the direct sale by land owners of the products raised on individual tracts, or the operating company could be entirely on a non-profit basis organized for production service only. The same corporation might or might not function as a marketing institution. Marketing organizations have recently been built up around single commodities. With respect to the production enterprise, while it must specialize, there undoubtedly will be a number of crops produced. The combination of enterprises and the relation to sales organization is a complicated problem. The possibilities are unlimited as to types of organization. The question is, What is the best type?

INVESTIGATION AND EXPERIMENT NECESSARY

What has been given is only a hypothetical framework upon which might be based a serious inquiry leading to a practical experiment. All that would be required to begin such an experiment would be a group of land owners willing to organize under the direction of an agricultural engineer or expert manager. This experiment should be supplemented with and preceded by additional economic research. In the early stages of such experimental development, ownership of the land could be retained by the original proprietors pending the successful outcome of the venture. The gradual purchase of farms included in the enterprise by the corporation might ultimately transform the institution into a land-owning as well as operating corporation, but this would not necessarily result. Organized effort in the direction of a practical experiment planned by practical men is the most effective way of getting results. The corporation which will be successful in modernizing agriculture will have important characteristics all its own. Organization in an area of diversified farming will be most complex. Any experiment involves the making of mistakes. The cost of these mistakes must be borne in the interest of research.

REGIONAL PLANNING

For many types of agriculture, the rural community of small farms may not become obsolete for generations to come. In other types, combinations of small allotments and large-scale production may be most efficient, while in some cases large-scale agriculture will predominate. The factors which will determine the character of development will depend upon regional differences. Regional planning should form an important part of future rural development. Regional planning cannot be carried out without some central organization to make and execute the plan. That central authority which would constitute the intellectual guidance, the authority of execution and the spirit of social betterment within local rural areas is an institution yet to be created. It is needed to make regional planning and economic rural development possible.

THE FUNCTION OF GOVERNMENT

The function of the federal and state governments throughout the evolution of agriculture may best be directed to education, experimentation, and the regulation and prevention of unwholesome tendencies. Large producing units in agriculture would probably ultimately be looked upon with such public concern that they might come under the same regulatory machinery as have the trusts and railroads. Certain important institutions will be unable to get a foothold and become established without actual government participation. The most important phase of government activity in our rural development is the local government, as yet non-existant, which should give local units individuality and powes to make progress.

Coordinating Building Plan Service[1]

By S. P. Lyle[2]

THE coordination of the agricultural engineering building plan services conducted by the U. S. Department of Agriculture and state agricultural colleges is no longer a novel enterprise. A beginning was made in 1912 at the sixth annual meeting of the American Society of Agricultural Engineers when a committee presented recommendations for conventional drafting symbols. The next record of advancement is a report of the Committee on Farm Structures in the A.S.A.E. Transactions (Vol. 7, 1914), inaugurating an extensively cooperative procedure for establishing recommended practices in four phases of farm structures work. In the same Transactions (Vol. 7, 1914) the Standards Committee recommended the use of four sizes of sheets for drawings and blueprints, based on the 8½-by-11-inch correspondence sheet size as a unit of area.

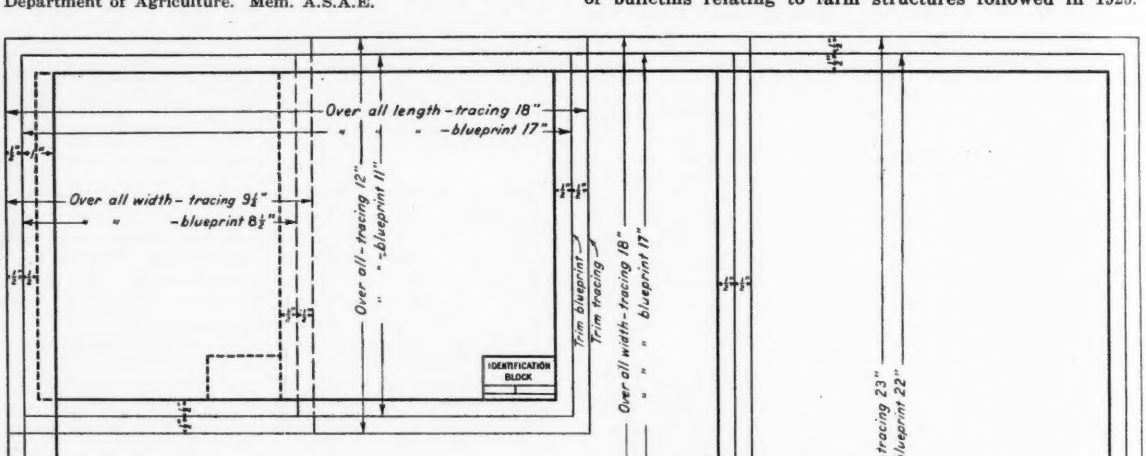
In 1923, the Committee on Standardization of Blue Print Service of the College Division presented a report (A.S.A.E. Transactions Vol. 17, p. 191) with an introduction as follows: "Your committee submits the following report together with recommendations for standard practice in the making and distribution of drawings and blueprints for extension work carried on by the Division of Agricultural Engineering of the Bureau of Public Roads, U. S. Department of Agriculture, the state agricultural colleges and experiment stations, and in addition, a proposal for a closer cooperation of these agencies to avoid duplication of effort and to promote the distribution of ideas from state to state."

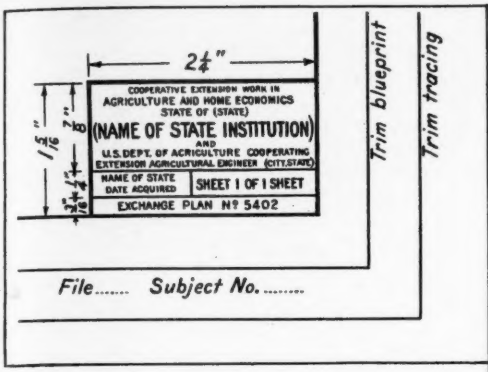
In the same report, under the heading "Information Gained," appear eleven paragraphs referring to various prevalent and recommended practices among which are four which refer specifically to a plan of exchange similar to the present plan. The committee closed its report with seven recommendations "For the adoption of blueprint standards by the American Society of Agricultural Engineers and their ratification by departments of agricultural engineering." The first three of these refer to dimensions of publications, drawings and blueprints. The fourth, which refers to the subject of this paper, reads as follows: "That the Division of Agricultural Engineering of the U. S. Bureau of Public Roads be requested by this Society to become the clearing house for blueprints and ideas between states; to check and approve new ideas for general circulation and to develop a standard practice in construction sheets." The remainder of the recommendations are proposals relating to putting the fourth one into practice.

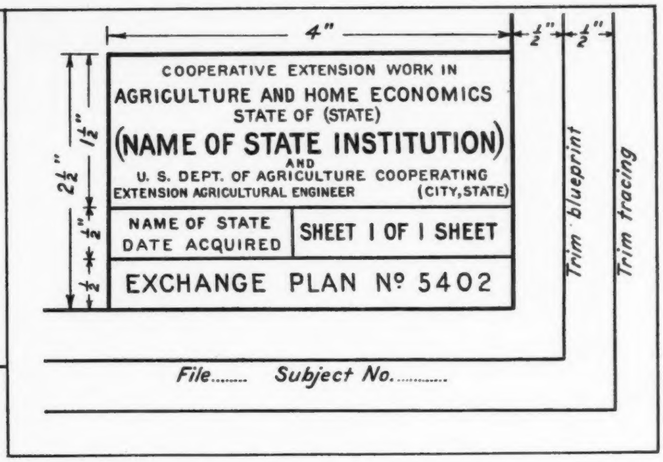
Since that report was rendered definite progress in line with these recommendations has been made as follows: "In November 1923, the first classified list of farm building plans was published by the Division of Agricultural Engineering, U.S.D.A., from a list prepared by the state colleges and the U. S. Department of Agriculture. A supplement to this list was published in December 1924. A list of bulletins relating to farm structures followed in 1925.

[1]Paper presented at the Structures Division session of the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June 1931.

[2]Senior agricultural engineer (extension specialist), U. S. Department of Agriculture. Mem. A.S.A.E.







As a continuation of this bibliography service there is now in the printer's hands a U.S.D.A. miscellaneous publication, entitled "A Bibliography Relating to Farm Structures."

In 1929, a classified list of 2812 farm building and equipment plans prepared by state agricultural colleges and the U. S. Department of Agriculture was published with subject matter classification and index appended, and was distributed to the colleges by the Division of Agricultural Engineering, U.S.D.A.

In the same year, 1929, the Office of Cooperative Extension Work and the Division of Agricultural Engineering of the U. S. Department of Agriculture cooperating published an illustrated volume of farm building and equipment plans and information series which was distributed to extension directors and agricultural engineers at the colleges.

From this list of available U.S.D.A. plans the states were invited to select any plans which they wished for use in extension blueprint service. Vandykes of these selected plans, with the name of the distributing state appearing in the title block, have been furnished now for a great variety of these plans in fourteen states. Other states have been using a large number of U.S.D.A. plans before the publication of this list.

In 1929 and 1930 the Division of Agricultural Engineering, U.S.D.A., conducted a national survey of work in farm structures. At the close of this survey the Committee on Cooperative Plan Service of the College Division of A. S. A. E., recommended the establishment of a system for an exchange of building plans between states on a basis similar to that already in force whereby states obtain vandykes of U.S.D.A. building plans for the production of blueprints for extension distribution.

In the fall of 1930, the Division of Agricultural Engineering and the Office of Cooperative Extension Work, U.S.D.A., made a survey of the extension factors and policies bearing on the general adoption of a state building plan exchange system. This survey revealed that sentiment in the states is highly favorable to the principle of exchange of plans, but that vandykes, the only medium of exchange used heretofore, were not thoroughly satisfactory. In response to this demand for reproduction of tracings for exchange use, the Division of Agricultural Engineering, U.S.D.A., can make provision for supplying on request either tracings or vandykes of building plans made available for exchange use.

In 1931, two significant steps have been taken to make the proposed exchange of plans between states a reality. The first of these was a meeting of farm structures men at Ames, Iowa, to which the department of agricultural engineering of Iowa State College invited the farm structures men from the faculties of land-grant colleges in the surrounding corn belt states, to discuss the inauguration of a coordinated system of preparing new building plans, insofar as possible, for regional instead of merely state-wide distribution and use. At that meeting the following general proposal covering procedure for the inauguration of a cooperative plan service was adopted tentatively as a working basis for the group of states represented at the meeting:

1. **Selection of Plans.** Regional committees composed of farm structures specialists representing colleges from groups of states with similar farm structures requirements shall select from the best available drawings the plans which most nearly meet their needs as a group. Revisions agreed upon shall be indicated on these selected basic plans. Committee meetings on convenient occasions are highly desirable for this purpose, but progress can be made through correspondence.

   In addition to its privileges on its own regional committee, any state shall be free to exert its influence in other regions in the selection of plans in which it is interested.

   Immediately on selection of a plan the regional committee shall forward a copy of the basic plan, with its revisions and voluntary preparation assignment indicated on it, to the repository office for filing and for comparison with other regional plans.

2. **Preparation of Plans.** Each committee shall assign the preparation of new tracings from basic state plans, among its membership, but will refer the redrafting of revisions of federal plans to the Division of Agricultural Engineering, U.S.D.A.

   The drawings not accepted by a committee from a group of states may still be used, but do not become a part of the approved cooperative plan service.

   The tracings of approved cooperative plans shall be prepared in accordance with standard regulations for the drafting of cooperative plans, which shall specify tracing material, tracing ink, sheet sizes, border sizes, trimming margin and lines, identification block (location, sizes, inscription and numbering system), title inscription, lettering practice, and conventional symbols. Bills of material, specifications and cost estimates shall be prepared for each tracing by the institution furnishing the tracing. Immediately on completion, each tracing shall be mailed to the repository office of the cooperative plan service, for the reproduction of a master tracing.

3. **Distribution of Plans to Colleges.** A repository office shall be established to perform the following coordinating services:

   1. File all cooperative plan service master tracings, bills of material, specifications and cost estimates.

2. Assign and insert the cooperative plan service serial number in the identification block.
3. Assign and affix the classification number on the trimming margin.
4. Mail a blueprint of the new tracing to each contributing state office.
5. Arrange for production and sale of Vandykes or tracings, with spaces provided in the identification blocks to insert the names of any state blueprinting service.
6. Arrange for production and sale of 8-by-10½-inch rotaprint copies of the cooperative plan series, for distribution in county agent plan books, and other purposes.

Three committees were appointed at the meeting to make recommendations for redrafting building plans for this region relating to (1) buildings for swine, (2) buildings for poultry, and (3) dairy buildings. It was expressly stated that no action of these committees was to be considered as mandatory on the structures' men of any state, the principal object being to direct energy now employed in needless duplication to the production of urgently needed new plans, which would each be useful to two or preferably more states. In order to promote uniformity in the style of these new drawings, the U. S. Department of Agriculture furnished sample blueprints and the following recommendations for standard practice in the preparation of cooperative plan service tracings based on former A.S.A.E. recommendations (A.S.A.E. Transactions, Vol. XVII, 1923):

1. All tracings shall be drawn on linen tracing cloth with black waterproof India ink, undiluted. Permissible sizes of sheets shall be 8½ by 11, 11 by 17, 17 by 22, or 22 by 34 inches, with 8 by 10½-inch size for rota prints.
2. Borders and identification block arranged as per sample.
3. Use any type standard lettering, plain easily read style preferred.
4. Use symbols commonly employed by architects and those set forth in electrical and mechanical handbooks for electrical and mechanical equipment. Symbols used on any given drawing to be explained by legends.
5. Title to be placed in the center of lower portion of sheet, and scales indicated below figures to which they apply; not in the identification blocks.
6. Identification block to contain date, number of sheets to a plan, originating state, and blank space for the remainder of the inscription to be filled in by the repository.
7. Especial attention must be paid to clarity of details and lettering where only one sheet (8½ by 11, 11 by 17, 17 by 22) is required for presenting the drawing, so as to permit of reproduction in rotaprint form.
8. All sheets of a design to be of the same size.
9. All working drawings to be at a scale of ¼ or ½ inch per foot, except special details, which may be ¾ inch or 1½ inches per foot.
10. Whenever feasible the bill of materials should be lettered on the tracing.

Since that meeting, men in structures' work in some of the other state colleges have also signified an intention to work in regional groups for the purpose of revising old plans or the drafting of new ones.

The second important step taken this year toward the realization of the proposed exchange system has been the acceptance by most of the state colleges of a proposal for the exchange of building plans now in use, between all states wishing to cooperate. This proposal was advanced to place the exchange system in operation immediately, as it is anticipated that the production of new regional plans will be slow at first, whereas the use of present plans, selected for their regional or national utility, should provide a very valuable exchange list of perhaps five hundred plans representative of the essential variations desired in covering the entire field of rural architectural recommendations of the federal department of agriculture and the state agricultural colleges. The cooperating states are now submitting the plans for the exchange system. The list of exchange plans will be selected from these as soon as all of the plans to be contributed are received. It is hoped that the tracings and Vandykes from this list may be made available by 1932.

Since the building plan exchange proposal has been under consideration for some years and has been endorsed in principle almost unanimously by the farm structures men of the A.S.A.E. College Division, there is no reason to bring its advantages to your attention at this time. The plan has now reached the state of reality. Its beneficial influence will be felt not only in extension service but equally in research and teaching work. There is, however, it has seemed to those concerned with the development of this plan exchange system, an immediate need for the formulation of recommended practices for the preparation of all new drawings, and since the formulation of such recommendations for standard practice should influence commercial as well as college drafting of farm building plans for public use, it is suggested that the A.S.A.E. Structures Division draw up the recommendations.

AUTHOR'S NOTE: The Bureau of Agricultural Engineering, U. S. Department of Agriculture, Washington, D. C., will supply, on request, a brueprint illustrating full scale the title blocks and standard sheet sizes referred to in this paper.

Engineering and Human Happiness[1]

IN THESE days of unusual unemployment . . . . there are men who question the assertion that engineering has promoted human happiness. Engineering has contributed to the welfare and happiness of mankind, as can be shown by sound information. The question might well be, "How wisely has mankind used the means for happiness provided by engineering?"

Even the engineers, chemists and industrialists, who have provided present day society with its astounding equipment for production, have given relatively little thought to the deeper effects of their achievements upon the lives and characters of men and communities and peoples. The painful present effects of our neglect of the immaterial, or spiritual, consequences of our progress are demanding a reckoning. Capacity has been achieved. Ability to discover and develop more and better goods and services also is part of the world's present equipment.

How to divide the benefits of engineering progress has not yet been well enough learned by business to maintain without disastrous fluctuations the steady flow of enjoyment through well ordered production, distribution and consumption.

Spread and absorption of sound information on these subjects among Americans, with their capacity to follow thinking with acting, will surely clarify the present confused situation and lead to workable solutions. Americans do not relish fog with its dangerous, unpleasant impedence of the journey and its doleful sirens. They love sunshine and full speed ahead. The steady sunshine of sound prosperity is all around us ready to be enjoyed as soon as wise leadership and intelligent following will break through this man-made mist of stupidity.

[1]From "Research Narratives," Vol. 11, No. 9 (September 1, 1931).

The Future of Chemistry in Agriculture[1]

By O. R. Sweeney[2]

IT WOULD seem, at the present time, that agricultural engineering efficiency has so reduced the need for men on the farm that a very much smaller group of men can produce the foodstuffs we need in North America, and as a result a considerable portion of the farm population are being crowded off the farm. These people are segregating into large cities where I believe it is agreed they are not so well cared for. I could spend a considerable portion of my time in proving that large segregations are not desirable. I think I could show that the overhead in running such a city as New York or Chicago has practically reached the prohibitive mark. Neither one of these cities is running on a business basis. They are all getting deeper and deeper in debt. I do not believe they are economic from the standpoint of modern, stable civilization. It is my belief that we will have to scatter our population, that we will have smaller communities scattered throughout the country, and that these communities in particular will be developed in the salubrious region of the "corn belt" where they can be easily fed and cared for. The reason our excess population is going to the large cities is because there are factories and jobs in those cities; and paradoxical as it may seem, the reason why factories are located in large cities is because labor is readily available there. A review of history will show that every great civilization has failed when the population became highly segregated.

The power situation has reached a point where it is not a serious factor. Due to the splendid transmissions the electrical engineer has worked out, it is possible to get an electrical rate in most any portion of the corn belt that is quite in line with power rates any place. Accordingly, if we could develop raw materials in sufficient quantities to establish factories throughout the great food region of the United States, there would be no reason why such factories should not develop and why we should not solve our great economic problem relative to the population quite easily.

There is ample raw material to establish a large number of factories throughout the agricultural region, and there is a demand for these raw materials. It is my feeling, however, that agriculture should not concern itself wholly with the food problem, but should consider the farm as a source of raw material for a great many other things.

After we have grown enough beef and pork and wheat to feed the nation, we have reached the limit. A man can eat only so much. If we advise that he eat more bread, he will eat less meat. If we advise him to eat more sugar, he will probably eat less bread; so when we have reached the limit of a man's capacity to consume food and clothing we have reached the limit of our present farm market.

Whenever we go to the subject of luxuries, shelter and amusements, we find a totally different problem. The number of radios, automobiles, summer homes and yachts that a man can use is directly proportional to the salesman's ability to sell them to him. When we begin raising radios and automobiles on the farm, we will greatly increase the demand for farm products, and whenever we divert foodstuffs to these products, we will have the advantage that we are taking some of this material out of the food market and putting it into a place where at the present time it is non-competitive. Accordingly, the supply of food products can be kept where it legitimately belongs without curtailing production.

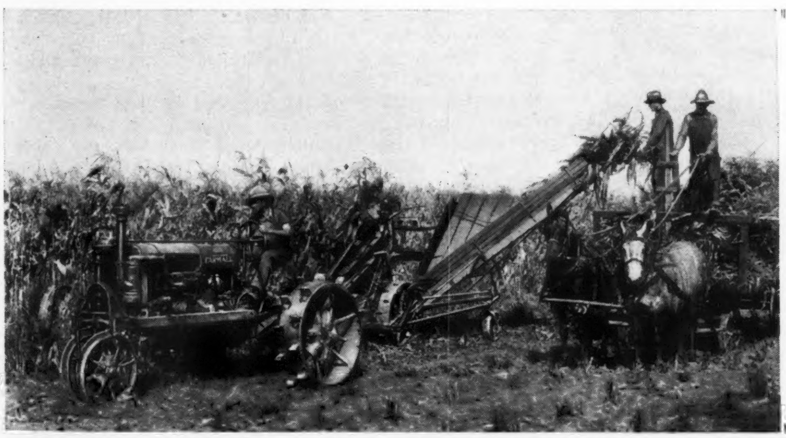
As I see it, curtailment of production is never a solution of a problem. Anyone can tell us if we are making too much steel to shut the factories down, or if we are raising too much corn to stop raising it, but of course this does not prevent us from going into bankruptcy.

If I had the time, it might be interesting to tell you how corn at the present time is being converted into all sorts of things. For example, there is about ¼ bushel of corn in an average size automobile in the form of paint, and about ¼ bushel of corn in the ordinary grand piano. This corn finds its way there in the form of butanol which is made by fermenting corn. A very considerable quantity of corn enters this market. The non-food uses of corn alone are comparatively large, but trivial as compared to the uses to which corn can conceivably be put. Indeed I think a fair estimate by a chemically minded person would be that at least 50 per cent of the corn produced in the United States might easily find its way into the chemical industries, from which it would exit as a material suitable to meet the market and be used exclusively for non-food purposes.

Little attention is paid to this important raw material, because it is the belief of many people that corn is an expensive material. The facts of the matter are that it is a very cheap raw material rating well below many raw

[1]Paper presented at the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June 1931.

[2]Professor and head of the department of chemical engineering, Iowa State College.



In a radius of five miles about a plant, if one-third of the land is in corn, which is about the average condition in the corn belt, it is possible to collect enough stalks to produce 223,000 feet of wallboard or 27 tons of paper per day for 300 working days per year

materials which are used in enormous quantities in the chemical industries.

It is not my purpose, however, to talk to you about what could be done with corn, but rather what has been done both experimentally and commercially with the great waste materials which are a by-product of agriculture. I allude to such things as corncobs, cornstalks, oat hulls, peanut shells, tobacco stalks, and cotton stalks, hulls, burrs, etc. An estimate which I think is relatively close, places the total amount of these materials produced every year in the United States, at exactly the same place regularly year in and year out, as one billion tons. Now, if you realize that coal, the bulkiest raw material used in the United States, represents at its peak only 480 million tons, you can see what a vast amount of raw material this agricultural waste substance represents.

The argument will be immediately raised that this agricultural waste material is widely scattered and difficult to collect. Facts do not bear this out. For example, it is a fact that there is less lumber grown per acre per year than there is cornstalks. In from seven to fourteen years, an acre of cornstalks has produced as much material as an acre of wood has produced in a century, and I believe that under proper working conditions there will be less labor attached to the collection of this cornstalk material in this seven years, than there will be in felling and collecting the wood.

THE AGRICULTURAL ENGINEERING PROBLEM

The raw material gathering has been studied here at the Iowa State College by our agricultural engineering department. Likewise it has had two years of commercial testing. The experience to date has been quite encouraging, but of course the agricultural engineers will be called upon to do some mighty big things in the economical collection of this material, if it is to be made a large industry. A few of the materials such as oat hulls, peanut shells and cotton seed hulls are frequently segregated in one place. Two plants in the United States segregate 900,000 tons of oat hulls between them, but in the main, the straw is scattered out over the ground, averaging about 2 tons to the acre, and by the time it is collected, under normal conditions, perhaps 1½ tons to the acre is a fair estimate.

To give you some idea of the value of this raw material, let me give you an illustration. In a radius of five miles about a plant, if one-third of the land is in corn, it is possible to collect enough stalks to produce 223,000 feet of wallboard or 27 tons of paper per day for 300 working days in the year. This is about the average condition in the corn belt. In some places in the corn belt, however, 60 per cent of the land is in corn, and in these regions it is possible to produce 401,900 feet of wallboard per day, or 50 tons of paper, from the above area. If, however, we include the straw, weeds, and other materials of low value on the farm, this figure will be increased about one-third or more. Five miles is not a very long haul.

I believe that when this problem is properly evaluated by agricultural engineers a machine combination will be worked out which will make the collection of these materials a much cheaper proposition than it is today. For example, at the present time for the big plant at St. Joseph, Missouri, straw is baled from the stack. It would seem to me to be a simple matter to bale the straw at the time it was threshed, substituting for the wind stacker an automatic baling outfit, which should materially lessen the cost of baling the straw. Davidson[3] and Collins[4] have shown they can bale stalks in the field about as cheaply as they can drag straw from a stack and bale it. However, that is your problem and I am sure that more mature thought on it will result in greatly reducing the cost of this important raw material.

Granting that an enormous amount of raw material is available, which cannot be disputed, and granting that it can be economically gathered, which I think has been demonstrated, the question naturally arises as to what we are going to do with it, and at last I have the problem down to a point where the chemical engineer can be of some help. Statistical figures are very tiresome but a reference to the various bulletins issued by our engineering experiment station will show the tremendous rate at which the forests of the United States are being depleted. The United States is faced with a shortage of timber, and that in the near future. The shortage of timber, however, is not to my mind serious, because I believe we can synthetically produce lumber and paper cheaper from agricultural wastes. But if we want to keep the great agricultural areas of the United States producing, we must study this forest situation carefully.

It is said that the Spanish peninsula was once bathed regularly with rain and was a fertile place, but by denuding the great peninsula of its forests, it was converted into a semi-arid region where it is difficult for any one to make a living. Many economists attribute the great economic hardships in China to the fact that they have cut down all the forests from their lands. The statement is frequently made that forests do not cause rain. I confess that I do not know why the forests cause rain, and I do not think it is a matter of causing rain at all. The question is a matter of relaying the rain back into the hinterland. For example, the prevailing winds that reach the corn belt are from the Gulf of Mexico and come northward. Let us suppose that these winds carry rain clouds as far north as Birmingham where they are precipitated along that parallel. This water immediately runs back through the Alabama, Tombigbee, Mississippi, and other rivers into the ocean, unless held. The large trees in a forest evaporate, on the average, 2½ tons of water a day. This vast quantity of water, instead of going to the ocean through the rivers, is carried by the air into which it is evaporating, further north, let us say for illustration, to the region of Nashville. Now, if on precipitation it is evaporated into the air by another large forest, it will be carried on north until it reaches Indiana, Illinois, and Iowa. The function of the forest is not to create rain but to relay water into the heart of the country. It can be seen therefore, that forests are very important and should not be cut down. This subject in itself is well understood and need not be discussed here. I believe it can be accepted as axiomatic that this country must not have the forests cut down if the middle section of the country is to remain fertile.

Now I want to point out that there is, with the exception of tree fruits, not one product growing in the forests of the United States for which a substitute cannot be made from cornstalks, straw, or other agricultural waste materials. I further want to point out that the progress of humanity has been largely parallel to man's changing from perennial to annual crops. When primitive man was forced to depend upon perennials for his livelihood we had primitive culture. With the development of the annual crop, which is more easily controlled by mankind, civilization has made its greatest advances.

The one great perennial crop that is used today is the forest. There is no reason, as far as I can see, why the production of paper, lumber, wood chemicals, etc., should not come from annual crops, if we substitute for the cellulosic bodies obtained from wood the cellulose obtained from waste agricultural materials.

IMPROVEMENTS ON FOREST PRODUCTS

Maizolith is a material denser than the densest wood grown anywhere in nature; denser than teakwood, for example. It is also harder than the hardest wood grown in nature and is many times stronger than the strongest material that is grown in nature. This particular piece (displayed) has a modulus of about 40,000 as against 7,000 or 8,000 for the better grades of wood. Its durability is uncanny. Made into cogwheels or bearings it will outlast steel many times. It is not difficult to make. The process con-

[3]J. B. Davidson, professor and head of the department of agricultural engineering, Iowa State College. Charter Mem. A.S.A.E.

[4]E. V. Collins, agricultural engineer, Iowa Agricultural Experiment Station. Mem. A.S.A.E.

sists of cooking corncobs with caustic soda, running them through a machine to cut them up into a fine jellylike mass, and running the material into molds which cast it roughly into the shape desired. In a short while the material shrinks down, becomes solid, is then taken from the molds and is allowed to season from seven to fourteen days. After that it is thoroughly seasoned and does not shrink further. It is turned accurately to shape and is made up into a finished product. The special uses of this material are those to which engineers and architects would put a superior hardwood. It is ideal for sporting goods as gun stocks, dice and shuffle boards. The beautiful polish that it takes makes it highly suited for architectural adornment.

Another material made by a different process is not so hard as the previous material and is much less expensive to make. The process to produce this is comparatively simple. We take cornstalks or oat straw, and grind it up until it is thoroughly pulped. It is then run over a special forming machine and after it is formed into a mat about one inch thick, it is squeezed in a heavy hydraulic press at 400 pounds pressure and steam is turned into the platens of the press. In 20 to 30 minutes a sheet of this material is developed. It is standard practice to make these sheets 4 feet wide and 6, 8, or 10 feet in length. However, we can make them as wide and as long as we wish.

The hardness of synthetic lumber is regulated by the pressure under which the board is made. There is practically no wood grown in nature for which we cannot make a substitute, knotless and free from grain. This material sells for $40 to $50 per 1,000 square feet. It is stronger, better in most respects than wood, and is cheaper than corresponding grades of wood. I see no reason why the bulk of the lumber in the United States could not be made as a by-product of agriculture.

In particular, I would call your attention to this material which is called a synthetic lumber, insulating lumber or wallboard. It does not appear to be anything like as strong as wood, but nevertheless houses built substituting this material for shiplap sheeting have proven to be actually, by test, 60 per cent stronger. The reason is that the material is put on in large pieces and has no cracks. The actual wastage of material in a house being built of wood is somewhere in the neighborhood of 20 per cent. The corresponding wastage in this material is something less than 2 per cent. Nailed on the outside it is a substitute for sheeting. Nailed on the inside it is a substitute for lath. It takes a coat of plaster spendidly. In a house built of this material not only has there been a considerable monetary saving, but it is estimated that there will be a saving of about fifty dollars a year on the fuel bill of an average six-room house. Not only will the house be warmer in the winter, but it will be cooler in the summer. This material is particularly valuable as an insulating material. Railroad refrigerator cars, household refrigerators, and large refrigerator units, are all using this in preference to cork.

The cork situation is an interesting one, and illustrates clearly what advantages can accrue to a country if proper study is made of its raw materials. Up until a few years ago, the cork industry in the world was limited to a narrow strip of land lying around the tip of the Spanish peninsula near Gibraltar. This is the only place in the world where cork grows. The difficulty of getting enough cork to supply the world's needs is great. However, today by utilizing waste materials as sugar cane bagasse, cornstalks, spent licorice roots and wood wastes, the United States has made itself practically independent of Spanish cork.

It has often been a matter of surprise to me to know that the military organizations of this great country would develop the use of cork so greatly without realizing that in case of a war all that was necessary was to blockade the Spanish cork to leave us helpless. Today, however, we have found that we can make synthetically materials which substitute in every respect for cork. There is not at the present time anyone making bottle stoppers, but we have produced things in the laboratory here at Iowa State College which, with a little study, should be satisfactory stoppers for bottles.

Some very light insulating materials are made of the pith of the cornstalk. The insulating value of this material is nearly as great as of pure air. It has as high an insulating value as any material ever made, and is excelled only by a vacuum. In this brief sketch I have shown you samples of materials which have been produced at comparatively low cost, which cover the entire range of qualities of wood. I see no reason why the synthetic wood industry, insofar as its products are used for structural materials, should not supplant the present wasteful lumber industry. The lumber industry at the present time is only possible because it gives no replacement value to the forests. At the present time the lumber dealer finds synthetic lumber a more profitable material to sell than natural lumber. It harms nobody but the individuals who own forests and who are wrecking them. It is my belief that the federal government could afford to pay a high price for these forests and that it would be an economy in the end.

Turning to the matter of paper, the great advantage of agricultural waste materials as a paper material lies in the fact that the supply is always on hand every year. Corn grows in the same area. Whenever a forest is cut down, it is gone. One year's corn crop can be gathered with confidence that in the same area there will be a supply of cornstalks again the year following.

Cornstalks and straw can be worked up the same as wood for various grades of paper. The economy of this agricultural paper industry is about equal or perhaps has some advantages over wood, but if the paper was made in the proper manner, it could be greatly increased. At the present time wood is cut and piled and finally carried to the paper mill where it is made into paper pulp. The paper pulp is dried and shipped to the finishing mills where it is blended and made into finished paper. With a constant supply of raw material always at hand, the paper pulp and finishing process could be made into a single process without any intermediate steps. This should result in great savings. A satisfactory paper was made at Danville, Illinois. The plant itself has not been a financial success, but my opinion is that it is not because the process was not successful.

INDUSTRIAL CHEMICALS

Furfural is a liquid of unusual interest. Ten years ago few knew anything about it. It is doubtful whether you could have bought a pound of it. Today it is a product on the open market and is the cheapest aldehyde to be had. It is made from oat hulls in only one plant, located at Cedar Rapids, Iowa. It is a prosperous industry for the state. Perhaps 300 million pounds are now produced in a year. It has a very wide range of uses. The potential supply of furfural in the United States is in the neighborhood of 20 million tons a year. This is in the order of magnitude of the petroleum industry. With a larger production and the utilization of some of the by-products, there is no reason why this should not become one of the largest industries in the United States.

You all know of the great importance of Bakelite and similar phenol-formaldehyde condensation products. The raw materials which go into Bakelite are costly and the heat and pressure necessary in the molds make it a rather expensive material to manufacture. A similar material is made by treating furfural with a catalyst and pouring it into a mold where it sets in a few minutes. The material is cheaper than Bakelite and its molding operation much simpler. A wide use could be developed for this.

There is no reason why an industry of the magnitude of the petroleum industry in the United States today should not be developed using agricultural waste materials. About one-fifth of the corncobs, peanut shells, oat hulls, or cornstalks is convertible into furfural and there are valuable by-products obtainable from the remaining four-fifths of the material.

Charcoal, tar oils, and various products are made by destructive distillation of agricultural waste materials.

Acetone is made from corncobs. During the World War we ran out of acetone (used in cordite explosives), and the Allied nations were in a quandary to know where to get a quantity sufficient to pursue the war. The process which was finally worked out for making it consisted of a much involved operation. Had they only known it there was ample acetone to be obtained from corncobs and oat hulls. In fact, there were enough corncobs in Story County (Iowa) alone to have supplied the demand at the time.

The charcoal has interesting properties and will probably be used as a basis for internal-combustion engine material in the reasonably near future. Many other uses for charcoal can be worked out.

This heavy tar-like mass (displayed) on further distillation divides itself into a series of hydrocarbon oils. These lighter oils are valuable as solvents; the intermediate oils are splendid as motor fuels because of their anti-knock properties. The heavier oils have several proposed uses as flotation agents, but are particularly good as burning agents. The pitch which results has many of the properties of shellac and is being experimented by several large industrial firms as a substitute for shellac and for Norway pitch.

The South Favors Five-Room House[1]

By Dan Scoates[2]

THE present method used in teaching design of farm houses at the agricultural colleges has never seemed to me to be right. The common method, as everyone who has taught the subject or who has done any designing of houses knows, is to find a plan that almost suits, or does suit, and then revamp it. I have never liked this method, but in the absence of any other I have followed it.

In an attempt at the evolution of some better system of designing it was decided to make a study of the question, and the first thing that was done was to secure a number of floor plans of farm houses. Since I am located in the South and am studying this from a southern angle, naturally I secured plans of southern houses.

Through the work I did for a southern farm paper and their farm home improvement contest several years ago, I was able to get plans of 279 farm houses scattered pretty well throughout the South. Some of these houses were located in every state in the South. They were homes of farmers who were progressive because they had entered this contest. Therefore, I feel that they were a fair sample of the homes in this section of the country.

The first thing was to analyse these houses as to size. By sizes we mean the number of rooms and in considering the number of rooms we did not count the porches, bath rooms, or closets.

The accompanying graph shows the results of our investigation. The outstanding thing that perhaps one in another section of the country would immediately notice is the small number of two-story houses. The two-story houses were so small in number that we have not as yet analyzed them for the number of rooms. The vast majority of houses in this section of the country are one-story houses. There are probably many very good reasons for this, but as yet we have not determined all of them.

Another outstanding fact derived from this investigation is the large number of five-room houses, something over one-third of the total. The four and six-room houses came next.

This survey showed us that the five-room house was by far the most popular house, and as a result of this we started our investigation with this size house. Subsequent articles of this series will have to do with the five-room house, since it is the most popular with us.

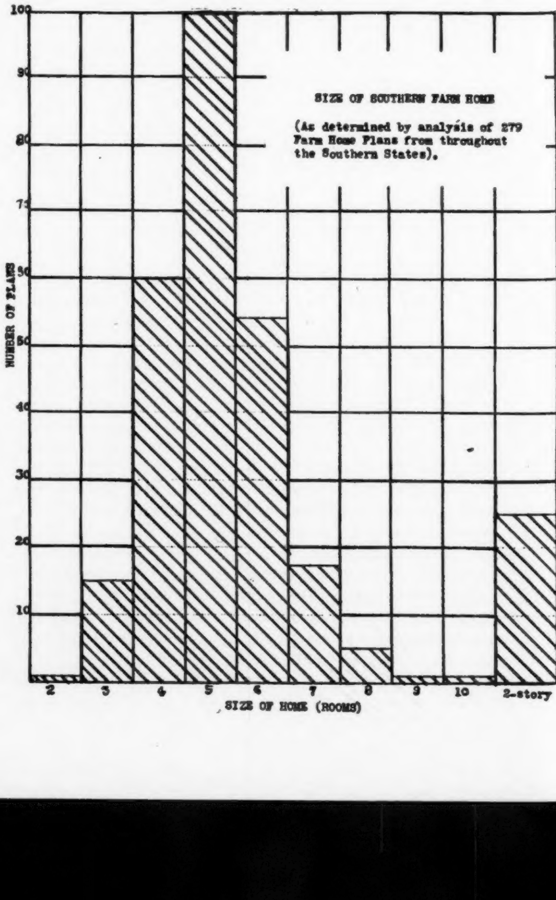
In looking around for additional evidence to show that the five-room house is the most popular size, we found this not difficult to secure.

In an analyses of the plan books of three ready-cut house companies we found that the number of plans shown for one-story five-room houses was the greatest with something like 103 plans, while the next largest was the four-room single-story house which had 72 plans; the next in order was the six-room two-story house with 65 plans.

The Architect's Small House Service Bureau in their new book of house plans, called "Small Homes of Architectural Distinction," have more two-story six-room house plans than any other. There are something like one hundred, and the five-room single-story house is next with 51 plans.

The rural sociologists have done some work on sizes of houses, but they have averaged their figures which is not of much use as far as the selection of the most popular size house goes. Their results, however, are indicative. They found, for example, in analyzing 2886 farm homes for three sections of the United States that the average number of rooms was 6.8. When this was divided out into sections of the country, they found the average size house for New England to be 9.6; for the South 5.9; and for the North Central states 6.9.

There is no doubt that the most common size farm house will vary in the different sections of the country as will the number of stories the house has. I have no figures to determine whether this same situation prevails in city homes or not, but as far as the country is concerned, and in the South in particular, it seems that the five-room house is by far the most popular.



[1]First of a series of articles presenting the results of an engineering investigation of farm house sizes and design.

[2]Professor of agricultural engineering, A. & M. College of Texas. Mem. A.S.A.E.

The Place and Function of Land Reclamation in the Agricultural Program[1]

By James A. King[2]

LAND DRAINAGE

Drainage is a part of two of the major heads into which I have devided the subject of land reclamation. It has been a factor in the opening up of new lands. It is an important factor in tuning up the established farm units. It is now taking its place as an essential element in the protection of many farm lands against damage by erosion. Also, it has been found to be an essential correlary of many irrigation projects to make possible complete control of the depth of the soil water table, and to prevent concentration of injurious soil compounds.

In the early beginnings of land drainage, back even before the opening of the Christian Era and even down to very recent years, drainage was installed for the one single purpose of removing surplus water from the surface of the land, and from the soil and the subsoil. That is still its major function. But we are learning now that it renders important additional services. It ventilates the soil, increases soil temperatures, stimulates soil bacterial action, gives crops access to a larger supply of both plant food and soil moisture, lengthens the effective growing season, increases the rate of plant growth, and facilitates timely farm operations.

We are finding that drainage is a means of controlling soil water level and soil water movement to meet the varying needs of different crops, and is also an important factor in controlling the movement of the soil itself. In other words, land drainage is a healthy, growing science and art.

John Johnston near Geneva, New York, laid the first drain tile in America 95 years ago. The early drainage work done in this country was on individual farms. They tiled out wet fields or excessively wet spots in fields. Each farmer found his own outlet generally on his own land, for the pioneer drainage work was done in comparatively rolling land.

But the broad, flat, or gently rolling expanses in Ohio, Indiana, Illinois, Wisconsin, northern Iowa, and southern Minnesota, and in the deltas and alluvial plains of the great river valleys presented an entirely different problem. Here it was the unusual farm that had on it an open, natural ditch or stream which could be used as an outlet for tile ditches. Artificial outlets had to be provided before adequate and complete tile drainage systems could be installed.

[1]Second and last installment of a paper presented at the 25th annual meeting of the American Society of Agricultural Engineers, at Ames, Iowa, June, 1931. The first installment was published in the September issue.

[2]Advertising and publicity manager, Mason City Brick & Tile Co., Mason City, Iowa. Mem. A.S.A.E.

The problem was solved by legislation which empowered county boards of supervisors or district courts to construct outlet systems to serve the land in a distinct water shed, the construction costs being paid for by issuing bonds against the district, guaranteed by the county, which bonds were repaid by a drainage tax assessed against all lands benefitted by the outlet systems.

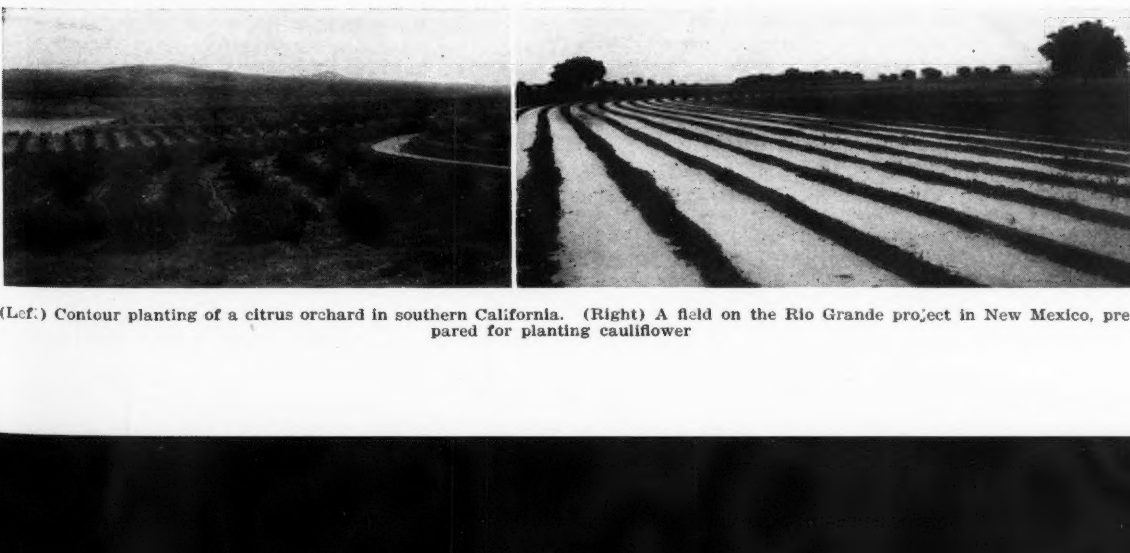
Following the passage of such enabling legislation in each state, there was feverish activity in the formation and construction of these outlet systems. In my home county of Cerro Gordo alone, there are now 100 of these official drainage districts. Other counties in the so-called drainage states are covered with equal thoroughness by such drainage districts. Now the once wet areas of these states I have named before are quite well supplied with these artificial outlet systems or drainage districts. The major flood plains of our larger river valleys are also supplied with combined levee and drainage districts.

Perhaps it will prepare our minds to interpret and help us to envision more adequately the import of some statistics to be given you in a few moments if we look at a few snap-shots of what are now highly developed farming regions—snap-shots showing them as they were before drainage worked her miracle on them. Compare these with our own knowledge of those same regions as they are today. Then the cold figures of statistics will leap into living, vibrating facts. These pictures of before and after, coupled with these statistics, will also be excellent arguments for continuing this important movement of reclaiming lands with the aid of drainage.

Let me quote you as follows from the historian's report of "Long's Expedition to the Source of St. Peter's River (now known as the Minnesota River) in 1823," written by a member of the party and published in 1825:

"Near to this house we passed the state line which divides Ohio from Indiana. The distance from this to Fort Wayne is 24 miles, without a settlement; the country is so wet that we scarecly saw an acre of land upon which a settlement could be made. We travelled for a couple of miles with our horses wading through water, sometimes to the girth. Having found a small patch of esculent-grass (which from its color is known here by the name of blue-grass), we attempted to stop and pasture our horses, but this we found impossible on account of the immense swarms of mosquitoes and horse flies, which tormented both horses and riders in a manner that excluded all possibilities of rest."

Again, "From Chicago to the place where we forded the Des Plaines, the country presents a low, flat, and swampy prairie, very thickly covered with high grass,



(Left) Contour planting of a citrus orchard in southern California. (Right) A field on the Rio Grande project in New Mexico, prepared for planting cauliflower

aquatic plants, among others the wild rice. The latter occurs principally in the places which are still under water; its blades floating on the surface of the fluid like those of the young domestic plant. The whole of this tract is overflowed during the spring, and canoes pass in every direction across the prairie."

When my Scotch-Canadian father came into the states during the Civil War, he worked for a time as a farm hand, "standing station" on an old Marsh harvester in the grain fields of this same section of Illinois. As wage, he was offered cash or his choice of an acre of land for each days' work, the land being located where now stand important suburbs of Chicago. It was such disreputable looking land, all swamp, reeds, cat-tails, bull-rushes, and wild rice, that his Scotch instinct prompted him to take his daily wage in coin.

You all know what that same section of Illinois is like today. Many of you are familiar with that region between Fort Wayne and the Indiana-Ohio state line. The much maligned practice of tile drainage worked that miracle of transformation. This same potent agency has transformed a considerable portion of Ohio, Indiana, Illinois, Wisconsin, northern Iowa, and southern Minnesota from a sad, sour, soggy region where farming was a discouraging fight with failure, into garden spots in the richest general farming region of the world.

I remember clearly an incident of my youth in central Iowa during the early '90's. My father had received a rather tempting offer for 1,400 acres of hill land he then owned in Guthrie County. With a team of bronchoes hitched to a buggy, he spent two weeks driving over the sections of northern Iowa where four acres could then be had for the price he was offered for one acre of our hills. The object of his trip was to determine if it would be a good venture to sell out and buy a larger tract where land was cheaper. At the family conference the night of his return, he said, "Well, folks, we will stay here. It is so cold and wet up there that they can never grow corn."

Father had driven over a considerable portion of that great V-shaped quarter of the state known as north central Iowa. In those days it was a series of gentle swells with broad low areas between; these flats were mostly pasture and wild hay land because they were too wet for the plow. At that time this section of Iowa was not good corn land. Today it is the land which makes Iowa the greatest corn producing state. Tile drainage wrought the miracle.

The trading zone of one small town in southern Minnesota illustrates well the point I wish to establish. In 1905 the two grain elevators operating in this town were buying a combined total average of 150,000 bushels of grain a year. In the spring over half the land in that trade area was under water for a week or more at a time. In 1922 the same elevators bought from the same trade area over 600,000 bushels of grain, with an annual average of one-half million bushels. The annual shipments of livestock and animal products doubled in the same time, and several whole trainloads of sugar beets were shipped out each year, and incoming freight had increased proportionally. Here, also, drainage wrought the miracle.

These are but individual cases selected from an infinite number to illustrate the transformation which drainage has brought about in individual farms and whole communities. These will help to put a little life, color and reality into the otherwise cold figures given now to show as best I can the vastness of drainage improvements existing in this country in 1929—the outgrowth of John Johnston's few miles of handmade drain tile laid 95 years ago.

Press releases from the Bureau of the Census under date of June 15, 1931 give the following figures which paint in gigantic proportions the picture of the extent and the cost of the formally organized enterprises functioning in the United States in 1929 when the census data was collected. These preliminary figures show that there were 67,713 of these formally organized projects located in 35 of our 48 states. The grand total area of land included in these projects was 84,815,500 acres—an increase of 29.5 per cent in ten years. The outlets and the mains serving these projects involved 130,457 miles of open ditches and 60,231 miles of tile ditches. There were also involved 7,612 miles of dikes and levees and a large but unnamed number of pumping plants. The total investment is given as $682,562,441, or an average of eight dollars per acre. These figures, of course, cover only the outlet systems and are independent of the much larger but not definitely known costs and extent of the internal detail drainage improvements.

Try to visualize what these figures mean. In 95 years the "seed of drainage" planted in New York state by John Johnston has grown and spread until it covers an area equal to two and one-half times the area of the state of Iowa included in formally organized and publicly built drainage projects. But this lacks much of being the total picture. To this must be added the hundreds of thousands, or even millions of acres drainaged by individual or private enterprise where the owner had his own outlet and did not need to form a public drainage district to provide an outlet.

In spite of the amply proved, well recognized benefits which adequate drainage brings to the individual farmer, I find that many land owners are loath to do any drainage at this time—loath even to lay a few rods of tile here and a few there, to extend an already established system which crop evidence shows was not carried far enough, to square up a field that is irregular in shape because of a small swamp in one corner of it, or to dry up a wet spot in the middle of a field. This loathness seems to grow out of a fear that the resulting increase in their own individual production will help to lower crop prices which are already critically low.

There are just three ways in which an individual farmer can increase his profit from any crop or product. These are: (1) Sell at a higher unit price; (2) Produce at a lower unit cost; (3) Produce more units at the same unit cost. The prevailing market price is beyond the control of the individual farmer. His unit cost and the number of units produced at that cost are within his own personal control. Therefore, these should be his first point of attack in solving his own individual profit problems.

Tile drainage reduces the unit cost of producing our major cash crops. It also produces more units per acre at this lower unit cost. What effect does this increased yield have on the domestic market, to say nothing of the world market price?

Suppose the largest producer of drain tile in the world were to double its annual sales of drain tile. Suppose its entire sales were laid in the farms of Iowa in fields now producing corn—not a foot put into new or idle ground. Suppose these drain tile increased the acre yield of those corn fields 50 per cent. They would have to continue with this program of doubling their normal sales for 14 years before they had increased the average annual production of corn in Iowa one per cent. It would take 107 years to add one per cent to the average annual corn yield of the United States.

Divide this effect up among all our major cash and feed crops and you will see that normal farm drainage activity has practically no effect whatever on the American domestic market price of those crops in any one year. And it has still less effect on the world market price. But, think what it does to the individual farmer who gets an increase of anywhere from 25 to 100 per cent in the annual yield of corn or any other crop from the same land, labor, and seed. It often means the difference between profit and loss.

We find to be quite general the impression that drainage has been practically completed in these northern Mississippi Valley states. The real fact is just the reverse — drainage has only just begun in these states. It is true that most water shed areas now have outlet systems, but that is only the beginning. That is only the foundation on which is yet to be built the superstructure of complete, profitable drainage.

You will be interested in the following summary of the results of a reconnaissance survey made a few years ago

Federal reclamation projects are the seeds of civilization planted in 40 per cent of our landed area now largely unoccupied and idle. From these seeds planted by the Government will grow units in our American civilization. These units in turn will grow and spread until this vast region is developed to its full potential capacity, to the ultimate betterment and the increased happiness of the rest of the nation

of Cerro Gordo County in north central Iowa—a standard county of sixteen congressional townships. There are now some 100 official county drainage districts in that one county. It is popularly assumed that therefore the county is thoroughly drained. It is true that this county is pretty well supplied with outlet systems, but that does not mean that the task of draining that county is completed, but rather that it has only just begun. In not a single one of those 100 districts has all the land needing it been supplied with detail lateral drainage. In fact, I doubt if there are a half dozen farms in the entire county that today have the last rod of drainage ditch which it would be profitable to install in them. If all the land in that one county, alone, on which drainage would increase the earnings enough to repay the cost of the drainage in five years were to be tile drained, it would require a drain tile plant with a producing capacity of 50 carloads a day, operating continuously for an entire year, to produce enough tile to complete the job of draining those lands in this one county.

As I have already said, the vast development of drainage in the level and gently rolling regions of the country would not have been possible without the enabling legislation which authorized the creation of drainage districts as petty units of our government, with the power to lend the public credit for financing extensive construction projects, and repaying their costs by levying taxes on the benefitted land. And yet, that vast development was accomplished in spite of a fundamental shortcoming or weakness in those legislative acts.

This is the provision that before the properly constituted authorities could order the construction of the project it had to be established that the proposed improvement would materially benefit the public by improving public health or safety. The proposed system had to drain a disease breeding swamp, or drain and thus make more safe a public road or right of way. This restriction prevented many worthy projects from having the use of the public credit to construct an improvement that would render a general service to the public in return for that privilege while it was doing an immense service to the individual land owner involved. Under this restriction or limitation of the law, only the outlet ditches were constructed. The problem of financing the detail drainage, the actual collection of the excess soil water to be dumped into the publicly provided outlet ditch was left to the financial resources of the individual landowner. To this day, many of them have not been able to solve the problem, and their fields still lack drainage beyond that first stage of the storm sewer supplied by the district outlet system.

It is my personal belief that where such restrictions still exist they should be removed. New districts formed should construct the detail lateral drains as well as the outlets. Districts already constructed should be enabled to construct complete detail drainage in all lands needing it within their borders. Wisconsin and Minnesota have already taken important steps toward that end.

This involves a principle which is fundamental and basic to both drainage and irrigation. If removing the excess water from lands is a public service which justifies the use of public machinery and credit, then these should be made available for constructing the works necessary to collect that excess from the soil as well as to carry it away after it has been collected. If putting water onto arid lands to supply their deficiency is a public service which justifies the use of public machinery and credit, then these facilities should be made available for preparing the land to receive the water and for constructing the detail distributing works required to put that water onto the land, as well as for constructing the main arteries of the system for delivering water to the borders of that land.

In both cases the basic purpose is to render a public service by putting new land into production or by increasing the productivity of lands that are already in use, and to do it in such a way that the earnings resulting from that improvement can of themselves repay the costs of that improvement. But a drainage improvement does not produce any earnings until the excess water has been collected out of the soil by detail lateral ditches which are an integral part of the system. Nor an irrigation improvement cannot produce any earnings until the land has been levelled to receive the water and means have been provided to deliver the water to each acre of the cultivated land. Therefore, I believe that public drainage or irrigation works should be constructed complete if at all. Otherwise the public has been prevented from receiving in the fullest measure that is possible the benefit which it should and is supposed to receive in return for lending its machinery and its credit to the owners of this land for their use in constructing those works. Otherwise, the securities sold to the public to pay for these projects are not as sound, as safe, or as secure as they could be.

Already one important step has been taken in correcting this fault in all our drainage district laws. In handing down its decision in a case known as Carter vs. Griffith, 179 Ky. 164, the Court of Appeals for the state of Kentucky ruled as follows:

"It will thus be seen that the right to establish a public ditch is not restricted to cases of benefit to the public health or to the public roads, but is clearly authorized where the improvement will result in public benefit or utility or will promote the public welfare. And since the reclamation of low or swamp lands for agricultural purposes is a public use not only because it enables the lands so drained to be used by a portion of the public, but it contributes to the public welfare by adding to the natural resources of the state, we conclude that the trial court erred in making the establishment of the ditch depend on the jury's belief that it would benefit the public health."

This decision is epoch making because it gives legal status to the broad basic principle that any material increase in the productivity of any material area of land constitutes a public benefit. In that one clause is summed up the foundation principles of all land reclamation work, whether by drainage or other means.

SOIL EROSION

Soil is our national heritage. On it as a foundation is builded our agriculture, out of which grows our entire civilization with all its intricate working and its maze of inter-related activities. If this foundation, the soil, is destroyed or lost, our national life will end and our civilization distintegrate until it has taken its place in history, along with those others that have lived and gone. Our very existence as a nation demands that we conserve our soil resources. Let me cite you two contrasting incidents to help drive home the potential for evil or for good for America that is wrapped up in this problem of the conservation of our national heritage in the soil.

In various parts of Asia there are now large areas which are practically devoid of all animal and vegetable life, and yet, scattered over these areas are ruins which indicate that at some time these areas supported a flourishing population. The civilization which once existed there is now no more, because the soil was ruined and lost by erosion.

A talented friend of mine, a skilled agricultural observer and analyst, tells of an interview he once had with an Italian farmer who, with much pride, was showing to him a magnificent crop of wheat growing on hill land in northern Italy. In answer to my friend's questions, his host said somewhat as follows:

"We are Roman farmers. This land has been in the possession of my family for over 2,000 years. Generation after generation, we have grown crops on this field during all these centuries. We watch it carefully. If some year a small spot in this field shows that something is wrong with it, we fix it up."

Through twenty centuries or more this family of Roman farmers has cared for and conserved their heritage in the soil. Consequently, the day my friend looked it over, he said it bore on its bosom the most beautiful crop of wheat he had ever seen in his long and intimate association with agriculture.

What has America done with her heritage in the soil? What is she doing with it today? What must she do with it tomorrow? What problems does it lay before the Land Reclamation Division of this society? Let me answer these questions in broad terms by means of apparently reliable statistics gathered from various sources.

In a single county in the Piedmont region 90,000 acres—or the equivalent of four standard townships, one-fourth of a standard county—of once cultivated land are said to have been permanently ruined by erosion. It is claimed that the land has been so devastated that it cannot be restored to cultivation by any artificial means now known to man. It can be restored only by the infinitely slow process by which nature makes soil out of rock at the average rate of about one foot in 10,000 years.

The total area of land in the United States that was once under the plow, but which has been totally and permanently destroyed for agriculture by gully erosion, is staggering. Estimates by skilled erosion specialists, based on careful and prolonged study, place this total at over 15,000,000 acres. Think of it—an area equal to one-half the great state of Iowa lost to American agriculture.

Let me adapt a graphic comparison from H. H. Bennett. What would this great nation do if some hostile foreign power were to march an army across our border and by force of arms seize from us one-half the state of Iowa?

Unlimited treasure and unlimited man-power would be consecrated instantly to the noble task of winning it back. But what will we do when this raping of the nation has been done by soil erosion, and is still being done at such an accelerating rate that, if left unchecked, it will take from us within the next generation an area equal to the other one-half of Iowa? The answer to that question is one of the problems to which the Land Reclamation Division of this society has consecrated its efforts.

Much of the soil washed from these eroded areas is deposited on rich lowlands to their detriment, or even to their ruin. All the streams of the nation are clogged and shifted in their courses by this sediment from erosion. The great storage reservoirs of power and irrigation projects are being filled up by this sediment, and their storage capacity against seasons of low stream flow is being diminished until some day in the future this reduced storage capacity will become critical.

Thus far I have talked only of gully erosion. Spectacular as is this gully erosion, it is of minor importance when compared with sheet erosion which at every rain storm picks up and carries away some of the finest grained and richest top soil of even our practically level lands.

Sheet erosion is the greatest thief which ravages our agricultural industry. Students of soils and geological forces say that in one year sheet erosion carries away from the farms of America as much of the mineral elements needed by plants as is removed by all of the crops produced in America in twenty-one years—more years than the average man farms for himself.

An eminent geologist claims that nature is making new productive soil out of what lies below the portions occupied by plant roots at an average rate of one foot in 10,000 years. Thus, if we are to maintain inviolate our national soil heritage, the average rate of sheet erosion should not exceed one inch in each 1,000 years. And yet certain unprotected soils with a slope of only two feet to the hundred have been found to be carried away at a rate as rapid as one inch in four years.

On practically every farm we can observe bald spots where the layer of top fertile soil has been removed by sheet erosion until the unfertile subsoil is showing through after only one or two generations of cultivation. The area of these bald spots is gradually widening. This process of sheet erosion has been going on in accelerated fashion ever since the wild sod, which was nature's shield against sheet erosion, was destroyed by the plow.

Here is a gigantic task—the heritage of a nation to be protected against an insidious and yet a ruthless enemy—confronting the agricultural engineer who is reclamation minded, and his allies—the soil technicians, the crop rotationists, and the farm managers.

Can it be possible that an area equal to one-half the state of Iowa is lost to American agriculture for the next several hundred or even thousand of years? Finding some profitable way of utilizing this land, or some economical method of restoring it to profitable agricultural uses is a

Badly eroded land along the Mississippi Valley in western Wisconsin, where clearing and cultivation strongly favors erosion. Settlement of this area started in 1865. Already some of the farms have been gullied beyond hopes of recovery for farming purposes. Few farms have entirely escaped and the problem of preventing erosion is growing. To prevent further damage the fields should be terraced and flumes installed at the heads of the gullies

challenge which must appeal to the best brains of this society.

Can it be possible that sheet erosion is removing plant food from our soils twenty-one times as fast as do our normal cropping methods? If so, can we not find ways of working these lands so that it is possible to earn an attractive profit, and yet, at the same time, retain in them the same heritage of fertility which they possessed when we received them, and hand it on, unimpaired, to the generation which is to succeed us?

This task of preventing soil erosion is not simple, in spite of the fact that it can be summed up in the one phrase, "Keep the soil where nature placed it." This task is made up of many factors and problems which are intricately interwoven and inter-related. One soil washes noticeably with a surface slope of less than one per cent; another is quite stable on a slope as steep as 15 to 20 per cent. Some top soils are deep and absorb rainfall rapidly, and have large storage capacity and a low soil water table. Other top soils are shallow with an impervious subsoil and so a high water table, or they absorb rainfall slowly and so produce a high percentage of surface run-off from all rains.

In some regions 95 per cent of the annual precipitation comes at a time when the ground is wholly frozen, and so impervious and non-erodable. In some regions there are often dashing winter rains when only a thin top layer—the richest soil in the field—is thawed out, and often much of this is washed away as completely as though scraped off by a road shaver. In other regions the ground never freezes, and so is eroded at every spell of precipitation. In some regions the rain all comes in such gentle patterings that an average soil absorbs it as rapidly as it falls. In other regions a large proportion of the rainfall comes in such torrential storms that only sand soils can absorb it as fast as it falls. In between these extremes are found many degrees of compromise and these in all the manifold combinations that are possible

The problem of preventing soil erosion may be summed up thus: Hold on the surface on which it falls as much of the precipitation as the soil beneath can use advantageously, holding it there until it soaks into the soil; then remove the balance without soil scouring and erosion.

In general, our crops can use advantageously all the rain that falls during the growing season without any of it being allowed to escape from the particular acre on which it falls Also, in most cases our crops will be benefitted if all the rain and snow that falls on each acre between the growing seasons is stored in the soil and subsoil. These two generalizations are subject to the modifying proviso that this excess which is absorbed from each storm, after it has restored the supply of film water by filtering down through the soil layer occupied by the crop roots, shall be stored in the subsoil so that the soil water table is below the normal root level.

If it were possible to store all precipitation in the subsoil of the acre on which it falls, we would accomplish many things of importance other than that highly desirable one of creating ideal moisture conditions for crop production. Among these affiliated accomplishments I might mention these of great importance: maintenance of the subsoil water supply, greater uniformity of stream flow, flood control, prevention of soil erosion and the resulting sedimentation of streams and reservoirs for water storage.

While the agricultural engineer is interested primarily in the control of this movement of water and soil in such a way that it will benefit and profit the farmer who owns and operates the land, yet he fails in his fullest duty if he does not consider these different subsidiary effects of the operation of the engineering works which he contemplates installing.

Land reclamation engineers have developed the only method that has proved successful and been widely used for preventing surface and incipient gully erosion. This method is what is known as terracing. Gently sloping ridges of soil are formed along contour lines of the sloping field. These ridges are so shaped that tillage and harvesting implements may be operated across them. They are spaced at such intervals that they arrest the flow of water down the slope before any material surface eroding has been done, and before even the most incipient gully erosion has started. The slope of these terraces along the face of the hill or ridge is so gradual that much of the surface run-off intercepted by them soaks into the soil, and what is permitted to escape does so at such a reduced rate of flowage that no appreciable eroding is produced. I am informed by the United States Department of Agriculture that three million acres were thus terraced in 1930 and considerably more will be so protected in 1931.

May I be permitted to make a prophecy at this time? It is this: Terracing, combined as needed with tile drainage and the planting and cultivating of crops on contour lines, will make agriculture reasonably safe and profitable in vast areas now classed as marginal or semi-arid lands.

Tile drainage will open up the clay soils and subsoils of these areas so that crop roots will penetrate to deeper reserves of plant food and soil moisture. Terraces and contour planting and cultivation will hold the none too generous rainfall until it has soaked into the surface instead of rushing into the water courses which are simply dry runs throughout most of the year. Tile drains can be so installed that they will carry to the streams what excess water overflows the contour rows of crops and is caught by the terraces; and in doing so, the tile will also act as subsurface irrigation ditches. Thus, practically the entire year's precipitation can be forced to pass through the soil before it reaches the streams because in these regions to which I refer, the bulk of the year's precipitation comes during the growing months as rain, rather than in winter as snowfall. And if so little as 10 inches of rain is forced to filter through the soil and subsoil as it falls, profit is assured for certain crops and types of agriculture.

The Land Reclamation Division of this society believes that the first task to be undertaken in solving the collective problems of soil erosion is to prevent further damage to land that is now under cultivation but shows signs of injury. The second task is to see that all new lands put under cultivation are free from the danger of erosion damage, or that the necessary protective measures are taken and adequate protective works are installed when the land is put into production.

We believe that the work of restoring ruined lands should be undertaken conservatively because of its cost and its difficulty. Of course, a small ruined area in part of a field that is otherwise in cultivation may be restored profitably, even though the cost is greater than the market value of an equal area of land which is as good as the rest of the field. This is true where such ruined areas are so located that they increase the labor cost of operating the rest of the field, or where they are a menace to livestock which is permitted to run in the main field at certain seasons of the year.

Reclamation of whole farms or larger areas now abandoned because of erosion damage is a matter to be weighed very carefully before it is undertaken. Estimate closely the cost of the engineering works that will be required, the length of time before the land will be back in full production, the probable annual net income during the years of restoration and thereafter.

Consider carefully whether or not the same capital would bring larger returns if invested in undamaged or in new lands. Consider carefully whether such lands would not be more adapted to forest or pasture uses than to cultivation—if, over a long period of years, the resulting smaller annual gross income would not give a higher percentage of net return on each dollar of the smaller initial cost involved. Then, consider just as carefully all the costs and other factors involved in creating more agricultural lands from lands now idle. Remember that abandonment is not the full and final solution of soil erosion problems. Weigh all the factors in each alternative against those in the other. Only thus may a wise solution be reached.

IRRIGATION

In the general and introductory section of this address, I have outlined to you the major factors which the Land Reclamation Division believes to be ample justification for a broad and constructive policy with respect to the reclamation and utilization of our natural resources in land Here is the appropriate place and now is the logical time to set forth additional facts and truths which apply more specifically to reclamation by irrigation than by other means, and which justify a well defined policy in favor of a reasonable development of irrigation projects.

In the western part of the United States, lying between the humid Mississippi Valley states and the shores of the Pacific Ocean, is a vast region which comprises some 40 per cent of our continental landed area. This two-fifths of our landed area supports only one-tenth of our population. Half of this 10 per cent of our population is found in three west coast states which comprise only about one-fourth of this region's area. Thus, five per cent of our national population is scattered thinly or only in spots over 30 per cent of our national area. Thus, this great region might be likened to a whole wing of some gigantic manufacturing plant standing unoccupied and idle.

What is more logical than for the owners of such manufacturing plant, with a vacant wing standing idle, to develop some sort of business which will put this unused space and equipment into production on a basis that will be profitable? This same principle applies to this practically idle 40 per cent of our total land area. We are not a well rounded and fully developed nation until this region is occupied and functioning constructively in whatever way may prove to be for the best interest of the nation as a whole.

This is a growing nation. Each generation finds one or more sections of the country facing the problem of providing for an excess population. Also, we are a fluid people. Because we are such, a certain portion of our population is always seeking a new country—the old spirit of our pioneer forefathers seeking new horizons and new frontiers to be conquered and developed.

I believe that the consistent development of this vast western domain will help solve both of these problems. It will serve as some place for the overflow population to go; it will serve as an escape valve for the adventure spirit of these modern prototypes of our pioneering forefathers. It will furnish the foundation on which they can and will build new units in our national civilization.

In fact, this vast region is already functioning in these two important ways, as shown by the last federal census. From 1920 to 1930 the total population of the United States increased only 16.1 per cent, or an average of 1.6 per cent per year. But during this same period the total population of this comparatively undeveloped western empire increased 41 per cent, or an average of 4.1 per cent per year. Moreover, the extent to which this 40 per cent of our landed area is acting as a receptacle for overflow population from our older regions, is increasing from decade to decade as its local food resources are developed. This is shown by the fact that the population of this region increased an average of only three per cent during the decade of 1910 to 1920, as compared with an average increase of 4.1 per cent during the succeeding decade of 1920 to 1930.

While we believe in the fundamental principles of developing this region, yet we do not advocate a hectic, high-pressure, forced development. Extensive projects which are definitely pioneering in character should be undertaken only after a careful, thorough study and analysis of all the factors which enter into the determination of their ultimate success. Also, we believe that due consideration should be given in such studies to the part which such projects will play in the larger problem of a well balanced development in this great region which is, in a large measure, still a frontier.

It is true that a large percentage of this vast region comprising 40 per cent of our continental land area is mountainous and so not usable for crop production. But much of it is usable for some economic purpose — some perhaps as national recreation ground; some for metal mining; because of the latent power resources adjacent to vast deposits of raw materials, some of it might be developed advantageously as manufacturing regions. But each part should be developed for the use in which it will render the greatest service to the nation as a unit.

But remember what I told you at the start of my address—no region of such magnitude as this can be developed constructively, adequately, and safely until local resources have been developed from which to supply the food needs of the population that is to occupy and live in this region. Sound development of such a region always comes after the provision of these food supply resources, and it always will.

As a great and growing nation, we need to develop this vast domain, much of which is now practically devoid of population, and much of which possesses great potential for essential service to the nation—a service which thus far is potential only. Moreover, the vacancy of this wide expanse tends to act as a barrier which interferes seriously with the interchange of men and materials between the older regions of the nation and the important civilization which has already been established as a fringe along the Pacific Coast, and which performs the highly essential function of America's front and gateway to the Orient. It is imperative that we develop this vast region of such economic and strategic importance if our growth as a nation is not to be held back and retarded. But this can be done only if local sources of food supply are developed.

It so happens that much of the agricultural land in this vast region does not have adequate, dependable, average annual precipitation so uniformly distributed throughout the growing season as to make crop production as safe as it is in the humid regions in the East. In order to grow crops profitably, this shortage must be supplied by irrigation.

In fact, practically the entire present development in this 40 per cent of our continental land area has been founded upon, was made possible and is now supported by irrigation. Without irrigation that whole region today would be advanced very little over what it was 75 to 100 years ago. Without irrigation it would be practically impossible to support a population of some 10 million souls inhabiting that region.

Remains have been found of quite extensive irrigation works that were constructed and used by a civilization now extinct but which, at some time, occupied parts of this region—probably at a time long before Columbus landed on our eastern shores. The early white settlers of this region lost no time in developing small and crude irrigation projects, without which they could not have produced the food supplies which were so essential to their very existence.

From these simple and crude beginnings, irrigation has grown until now it is practiced extensively in 19 states, from North Dakota to Louisiana, California, and Washington. Preliminary figures from the 1930 census show that in 1929 these 19 states had a total of 74,863 separate irrigation projects containing a total area of 30,800,126 irrigable acres, facilities for watering a total of 26,870,891 acres, and a total of 19,578,441 acres actually operated and receiving water artificially. Of this impressive total, less than 10 per cent, or only one and one-half million acres were in federal irrigation projects.

This foundation of an important unit in our American civilization has been constructed by individual land owners and by groups of farmers, by land development and colonizing companies, and by the governments of the individual states. I think no one questions the wisdom or the soundness of the fundamental principle of land irrigation by reclamation which has resulted in the present condition by this great region. But there remains out there something like another 24 million acres that are physically adapted to irrigation, and for which water resources are available.

Repeatedly we hear it charged, and often with considerable venom and no small measure of vehemence, that this is no time to develop new projects of putting such lands into production when American agriculture is already suffering from overproduction; that it is unsound economically, if not actually suicidal, to spend vast sums developing irrigation projects at high acre costs to compete with lands already in production. This criticism is directed especially at the federal government because of its activity in promoting irrigation projects. It is entirely appropriate that we analyze for a moment or two these criticisms of federal activity in the promotion of irrigation.

At the present time, the sum total of all the cultivated land comprised in all the federal irrigation projects of the great West, Southwest, and Pacific Coast regions is only 1,512,250 acres, or 15/100 of one per cent of all lands cropped in the United States. So far as is now known, all the remaining lands not now irrigated that it would be feasible to bring under irrigation in major reclamation projects is only about 24,000,000 acres, which equals only another 2.4 per cent of our total crop area.

The total production of food materials on federal irrigation projects is less than one per cent of the total production of the United States. Wheat is the only major grain crop produced in any material quantity on these projects. Even the production of that crop equals only one-half of one per cent of the national wheat production, and but 1/10 of one per cent of the world wheat production. The balance of the money crops grown on these projects are mostly specialties which cannot be grown of equal market quality, if at all, in our humid regions. These are specialties, many of which the nation would have to go without or import from other countries if it were not for these irrigation projects.

Here is another factor which should not be overlooked. The farm population of these federal irrigation projects is 153,663. Located on or adjacent to these projects, and supported and fed by them, are 212 towns and small cities with a total population of 451,811. In other words, here the ratio of rural to urban population is one to three, practically the same as the general average ratio for the nation as a whole. Since the chief product of these irrigated acres is specialty crops, then livestock, dairy products, and grains for food and feed must be imported in considerable quantities to supplement the inadequate quantities grown locally. Thus, to this extent at least, these federal irrigation projects actually increase, rather than reduce, the market for the products of the farms in the humid regions.

The planning and construction of any large irrigation project takes time and can't be done in one year, nor yet in five and often not in ten. In general, it requires an average of about 25 years from the inception of the plan for such a project until the engineering works are all completed and as much as three-fourths of the cultivated land is in production on a sound and profitable basis.

Necessarily then, any large irrigation project is a venture in pioneering. Those who plan it must have breadth of vision which comprehends the basic principles of national growth and development and which looks into the future and sees with reasonable clarity and definiteness at least the broad outlines of what may reasonably be expected to grow out of the proposed project within the next quarter or half century. Those who develop its lands must have the same courage, stamina, and fortitude of body and soul as characterized those who carried the advance banners of our civilization across the Appalachian Mountains into the valley of the Ohio and the Mississippi.

Such a project must be planned, and the essential works must be constructed, in advance of the time when the full productive capacity of the land included in the project will be needed by the nation. And since such a project is, in reality, the foundation on which is to be built later a local unit of our civilization which will also serve the larger and more complex needs of the nation as a whole, it seems but logical that the federal government should have a part in the initiative in planning such projects and in furnishing the capital for the costly engineering works involved—these costs to be paid back later by the individual operators of the lands out of the income from such operation.

The first projects undertaken by the federal government were the construction of dams, storage reservoirs, and vast conduits for the express purpose of salvaging struggling private ventures and transforming them from certain failure to assured success. These storage and distribution works saved from ultimate and certain ruin private investments which were much greater than the cost of the government projects constructed to salvage them. They saved whole communities that were struggling to establish themselves in what was once a barren and inhospitable region.

Following this first stage of rescue work, the federal government has gone out into vacant regions and developed projects of a purely pioneering character. One such project was developed in a barren unpopulated sage-brush desert in the valley of the North Platte River. In 1929 one town located in that project paid to one railroad $800,000 in freight charges alone. The freight charges paid each year by the irrigation districts along the Snake River in Idaho are more than all the combined freight charges paid by the entire state of Idaho before these irrigation projects were begun. In 1928, 17 of the 28 federal irrigation projects shipped in (in addition to outgoing shipments) 95,496 carloads of manufactured goods worth over $120 million.

Why burden you with facts and figures? It all sums up into this one fact: Federal reclamation projects are the seeds of civilization planted in 40 per cent of our landed area now largely unoccupied and idle. From these seeds planted by the Government will grow units in our American civilization. These units in turn will grow and spread until this vast region is developed to its full potential capacity, to the ultimate betterment and the increased happiness of the rest of the nation.

We can well concede that errors have been made by all interests involved in western irrigation, and yet not have to apologize for the basic principle involved or the general results obtained, or without needing to subtract one iota from our pride in them. We can admit the charge often made that the federal government will have to write off as a loss several millions in irrigation investments when reckoned on cold balance sheets, just as have the private adventurers, the professional promoters which were a so much greater factor in western irrigated agriculture.

And yet, we can compare this pioneering venture of converting desert wastes into productive fields with any other pioneering enterprises which have been undertaken by private initiative or business corporations along new or untrodden paths in the program for the development of the West, with results decidedly encouraging and reassuring. The combined losses in irrigation are picayune as compared to those in gold and silver mines. When it comes to telling the whole story and picturing all the countless contributions which irrigation and land reclamation have made to the sum total of human comforts and conveniences, statisticians may produce arguments which appeal to sceptics and the uninformed, but still they will fall far short of convincing those who have followed and who understand and sympathize with the difficulties, the achievements, the scientific contributions, and the added wealth and oportunities which have followed in the wake of and grown out of this movement.

(AUTHOR'S NOTE: Unstinted credit is hereby given the following fellow members for their assistance in furnishing material, making suggestions, and constructive criticism of the first draft of this paper. All were prompt, liberal, and frank. Without detracting from the credit due anyone else, it is only fair to give special credit to H. B. Roe for his exceptional efforts. I have wondered if some of it were not to ease his conscience for having unloaded onto me the job of preparing this paper, in his capacity as chairman of the Meetings Committee: H. H. Bennett, John W. Haw, L. A. Jones, N. A. Kessler, G. E. Martin, S. H. McCrory, W. W. McLaughlin, Elwood Mead, D. G. Miller, A. T. Mitchelson, C. E. Ramser, H. B. Roe, M. A. Schnurr, G. E. P. Smith, E. V. Willard, and Ivan D. Wood.)

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture. Requests for copies of publications abstracted should be addressed direct to the publisher.

Water Supply and Sewage Disposal Systems for Farm Homes, I. D. Wood and E. B. Lewis (Nebraska Station (Lincoln) Bulletin 245 (1930), pp. 44, figs. 23).—Practical information is given on the subject.

The Theory of External Loads on Closed Conduits in the Light of the Latest Experiments, A. Marston (Iowa Engineering Experiment Station (Ames) Bulletin 96 (1930), pp. 36, figs. 11).—The final results of an investigation, conducted by the station in cooperation with the U.S.D.A. Bureau of Public Roads, are presented in the form of data on and mathematical expressions of the theory of external loads on closed conduits.

Tractor Hitches, H. E. Murdock (Montana Station (Bozeman) Bulletin 229 (1930), pp. 34, figs. 45).—This is a bulletin of practical information relating to suitable hitches for pulling implements with a tractor. It deals especially with adjustments for implements and hitches, 2-, 3-, 5-, and 6-implement hitches, combination hitches and safety devices.

The Moisture-Saving Efficiency of Level Terraces Under Semi-Arid Conditions, H. H. Finnell (Journal of American Society of Agronomy (Geneva, N. Y.), 22 (1930), No. 6, pp. 522-529).—The results of investigations conducted at the Panhandle Agricultural Experiment Station, Goodwell, Okla., are reported. The use of terracing to utilize 2.33 inches of run-off water annually, which, when held on terraces, has a penetrating efficiency of 34.5 per cent, increased the annual supply of soil water from 3.58 to 4.38 inches.

The maximum depth of water permissible on the terrace at one time, L, was used as a constant expressive of the climatic and soil water relations peculiar to a certain locality and soil type because it may be used for more than one purpose. If this depth of water is known within reasonable limits, it can be used as an index number to determine the advisability of terracing for moisture saving and the size of terraces to use as well as the basis for calculating the proper distance between terraces on different slopes. A suggested method of estimating the value of L is as follows: $\frac{CD - AFP}{F_1E} = L$, where C represents the water-holding capacity of the soil in inches of plant-available water per foot of soil; D, the rooting depth of the crop grown in feet; A, the average annual rainfall in inches; F, the penetrating efficiency of the annual rainfall as percentage entering the soil; P, the percentage of total rainfall coming outside the growing season; F_1, the penetrating efficiency of terrace-held water as percentage entering the soil; and E, the average number of excessive rains received annually. The limit of terrace width would be calculated as $\frac{L^2}{^2 S A_1}$, with S representing the percentage slope of the land or matured terrace and A_1 the maximum run-off expected at one time.

Poultry House Construction, F. C. Elford and H. S. Gutteridge (Canada Department of Agriculture (Ottawa) Bulletin 132, n. ser. (1930), pp. 40, figs. 40).—Practical information is given on the subject, together with general and detailed working drawings.

Building Plans for the Dairy Farm, J. B. Kelley (Kentucky Agricultural College (Lexington) Extension Circular 128, rev. (1930), pp. 82, figs. 59).—This is a revision of Extension Circular 128. It presents working drawings and practical information on dairy barn construction.

Cleaning Sugar Beets in the Field and Mechanical Loading [trans. title], R. Bernstein (Technik Landwirtschaft, 11 (1930), No. 6, pp. 151-154, figs. 9).—Experiments on the field cleaning and mechanical loading of sugar beets are reported. The results indicate that on heavy moist soil the cleaning of the beets can best be combined with the loading, and point to the practicability of a portable loader and cleaner which can be attached to the wagon.

Stresses in Heavy Helical Springs, E. Latshaw (Journal Franklin Institute (Philadelphia), 209 (1930), No. 6, pp. 791-808, figs. 7).—An analysis of these stresses is given and formulas for design derived.

Scheme for the Classification of Agricultural Engineering Matter (Internatl. Review of Agriculture, Monthly Bulletin of Agricultural Science and Practice [Rome], 20 (1929), No. 12, pp. 496-500).—This scheme is briefly outlined.

Wood Construction, D. F. Holtman (New York and London: McGraw-Hill Book Co., (1929), pp. XII + 711, figs. 306).—This handbook is an attempt to supply a rapidly growing need on the part of architects, engineers, and builders for complete and practical information on the use of wood in construction. Fundamental facts concerning the nature and available forms of wood, and fundamental principles on the use of wood, constitute the most important part of the book. The aim has been to furnish basic information for use in designing and specifying wood construction, and to aid in the efficient selection and application of the material, and in the adoption of efficient and economical forms of design.

The first seven chapters include information on the factors affecting the use of wood in construction; lumber grading, grade provisions, and working stresses; the principal woods used in building and construction; the identification of common woods; preservative treatment; the use of paints and stains, and methods of preventing termite damage. The last four chapters contain information on approved methods of using lumber in light building construction and millwork, and in both heavy timber and temporary construction. In an appendix are given compilations showing the standard grades produced in the various species, and tables of the lumber grades used for various construction purposes.

Reinforced Concrete Bridges, W. L. Scott (London: Crosby Lockwood & Son, 1928, 2. ed., enl., pp. XII + 220, pls. 26, figs. 116). —This book deals with the practical design of modern reinforced concrete bridges from the English viewpoint, and includes notes on temperature and shrinkage effects. Other chapters deal with loading and wind pressure, influence lines, arch bridges, girder bridges, bowstring girder bridges, temporary and permanent hinges, foundations and abutments, and description of bridges. Appendixes deal with specifications and materials of construction.

Bulk Handling Grain from the Hillside Type Combine, H. Beresford and E. N. Humphrey (Idaho Station (Moscow) Bulletin 175 (1930), pp. 119, figs. 22).—Information is presented which indicates that handling grain in bulk offers a means of lowering production costs, provided a sufficient volume of grain is handled to warrant the necessary investment in equipment. The reduction in the labor required and the prevention of grain loss and possible injury to livestock may make bulking profitable under adverse conditions.

Good roads and reliable transportation facilities are essential to successful bulking operations. The direct haul method is adapted to short hauls and level fields where the contact by the motor trucks and combine may be made without delay. The use of an intermediate field bin will permit the bulking of grain from hillsides which are too steep for motor trucks and where the distance to the elevator would require more trucks than could be owned economically by one operator.

The combination of temporary storage and the direct haul method from the combine to the elevator is advantageous when it is possible to utilize the motor trucks on day and night shifts. The farm storage of grain provides the most flexible and convenient means of bulk handling direct from the combine. Portable farm elevators may be adapted readily to the transfer of bulk grain to intermediate field bins or the direct loading of railroad cars when the grain is shipped in bulk from the farm to the terminal warehouse.

The Column Analogy, H. Cross (Illinois University, Engineering Experiment Station (Urbana) Bulletin 215 (1930), pp. 78, figs. 27).—The object of this bulletin is to present some theorems dealing with the elastic analysis of continuous frames. The general conception referred to includes the principles of area moments and also the conception of the conjugate beam.

It is shown that bending moments in arches, haunched beams, and framed bents may be computed by a procedure analogous to the computation of fibre stresses in short columns subject to bending, and that slopes and deflections in these structures may be computed as shears and bending moments, respectively, on longitudinal sections through such columns. The theorem makes available for the analysis of plane elastic structures the literature of beam analysis, dealing with the kern, the circle of inertia, the ellipse of inertia, graphical computations of moments and products of inertia, and conjugate axes of inertia. Certain terms are defined in such a way that the method is extended to include the effect of deformations due to longitudinal stress and to shear in ribbed members, and to include trussed members.

The method has application in the fields both of design and of research.

The Harvester-Stacker Method of Harvesting Grain in North Dakota, H. F. McColly (North Dakota Station (Fargo) Bulletin 245 (1930), pp. 27, figs. 22).—The results of an investigation into the harvester-stacker method of grain harvesting are reported. This method involved the consideration of a machine composed of a 12-foot header which elevates the headed grain into a metal container approximately 7 feet in diameter. The bottom of this container or tank revolves so that the grain is deposited in it in layers or coils, with the heads inclined toward the center and the butts of the straw toward the outside. The stack is built in this tank, being packed by a revolving corrugated conical packer at the top and a cylindrical roller at the side near the bottom. The finished stack is approximately 6 feet high and so woven and packed that it resists weather well, yet the grain is easily pitched into a thresher without scattering. The stack is dumped by power lifting the rear half of the tank the tank having traveled to the rear of the carriage track. The tank bottom inclines to the rear and the stack slides off.

The results showed that stacks built by the machine when properly operated, protect the grain from excessive shrinkage, and the quality of both grain and straw is improved by the stack going through the sweating process. The stacks are more easily hauled to the thresher on the sweep rake than bundle grain on racks. The stacked grain is as easily pitched into the extension feeder as bundle grain into a feeder.

This method saves all the straw except in a tall crop. Since the best stacks are built from straw about 18 inches long, no more than a binder would leave is left in the field when the standing crop is around 30 inches in height. This method also develops a high quality of grain and straw, and provides a temporary grain storage in the stack if necessary. Comparing it to some other harvesting methods, it saves labor, time, twine, permits earlier plowing, and does not scatter foul weed seeds over the field.

Disposal Studies for Milk-Products Waste, E. F. Eldridge (Engineering News-Record (New York), 106 (1931), No. 13, pp. 520, 521, figs. 2).—Studies conducted by the Michigan Engineering Experiment Station are reported. These led to the conclusion that primary biological filtration is the most promising method of any yet devised. Fair-sized experimental filters have reduced the unstable material in raw milk waste by as much as 93 per cent. The effectiveness of the treatment was found to depend upon a careful control of the strength and character of the waste applied, a factor which largely accounts for the lack of success with this method of treatment in the past.

The experimental units used for the studies consisted of a storage tank, orifice box, dosing tank, and filters of gravel, cinders, sand and brush. The gravel filter was 10 feet in diameter and 10 feet deep and was composed of 1.5 to 3-inch stones. Dosing was accomplished by means of a revolving-arm sprinkler. Gravel or crushed stone of about 1.5 to 3-inch grade makes the best filtering medium. The maximum rate of application for sand is 0.15 mgd (million gallons per day) and for gravel or cinders 1 mgd per acre.

The maximum biochemical oxygen demand value for the waste applied to a sand filter operated at the 0.15 mgd rate is about 1,500 parts per million. With gravel or cinders operated at 1 mgd, its maximum is about 1,700 parts per million biochemical oxygen demand. If a higher rate is used the strength of the waste should be reduced accordingly. The depth of the filter depends largely upon the character of the effluent desired. For sand 30 inches is ample. Gravel and cinders require a much greater depth.

It is necessary to provide a storage tank with about 3 to 4-hour detention to smooth out the peaks in the volume and strength of the waste discharged from the milk plant. Provision should be made for draining and cleaning this tank and for dilution of the waste if necessary. This dilution can be accomplished in many cases by diverting a portion of the condenser water into the waste to be treated. Where a vacuum pan is not in operation, direct dilution may be necessary if the strength of the waste is above the maximum recommended for effective filtration.

The Use of Agricultural Machinery in Canada and the United States of America, T. Baxter, G. Clarke, and J. E. Newman ([Great Britain] Ministry of Agriculture and Fisheries (London) Bulletin 27 (1931), pp. IX + 38, pls. 12, fig. 1).—This is a contribution from the National Farmers' Union, the National Union of Agricultural Workers, and the Institute of Agricultural Engineering of the University of Oxford, all of Great Britain. It presents the results of a first-hand study of the principal mechanical methods and equipment used in American and Canadian agriculture and an analysis of these in the light of the requirements of British agriculture.

Report on Land Drainage Experiments at Baramati, C. C. Inglis and V. K. Gokhale (Bombay Public Works Department (Bombay, India), Technical Paper 24 (1928), pp. [4] + 19, pls. 27, figs. 2).—A large amount of data on the results of land drainage experiments under irrigated and alkali conditions are presented and discussed. A large number of conclusions are also drawn.

Among other things, it was found that drains to be effective must be located in porous material and should cut through it to a considerable depth. Drainage takes place along the layers of stratification and in the direction of the "dip" and only to a very limited extent against the dip, or normal to the stratification. Intercepting drains are only partially effective unless they are taken down to an impervious bed such as rock. Where the porous stratum is deep they have little effect, the pressure being transmitted through the deeper layers. Drains excavated down the slope are usually much more effective than those excavated normal to the direction of the slope of the ground. It is wise to err on the side of overdrainage rather than underdrainage, because once perennial irrigation has become established it is very costly and often very difficult to construct new drains or enlarge old pipe lines.

Where there is a fairly porous substratum, salts can be removed by merely flooding with 6 inches of water for from 3 to 4 months, after shallow drains have been excavated in the vicinity of the flooded plats. Where drainage is poor the addition of one ton per acre of finely ground gypsum before flooding is desirable In the Dekkan drainage is generally possible, and wherever the damaged area is fairly concentrated and there is a reasonably contiguous outfall the cost of protecting areas does not exceed 50 rupees ($18.25) per acre. Where the substratum is moderately porous, reclamation is simple.

[Agricultural Engineering Investigations at the Illinois Station] (Illinois Station (Urbana) Report 1930, pp. 96, 97, 199-221, figs. 5).—Progress results of studies in agricultural engineering are briefly reported (Agr. Engin., 11, p. 192).

Studies by C. W. Crawford and E. T. Robbins of the pulling power of 109 teams of horses and mules, as indicated by a dynamometer, showed that the big teams pulled the heaviest loads. Pulling power seems to be closely associated with large size, great heart girth, energetic but calm disposition, and good driving. Horses in good flesh and with sharp shoes also have an advantage. The results indicate that horses have immense reserve power for emergencies, such as moving loads through soft ground or up hillsides.

Data also are reported on farm uses of electricity, septic tank operation, crank-case-oil tests, the life of the farm tractor, draft of farm implements, and soil erosion control.

In the corn borer control studies, A. L. Young, R. I. Shawl, and R. B. Gray of the U.S.D.A. Bureau of Public Roads found that, although very good covering of debris is possible with 14-inch plows when properly equipped, especially if liberal clearance is provided beneath the beams for the passage of trash, particular care on the part of the operator is necessary if good results are to be secured. Bottoms specially shaped so that they pitch the dirt farther and leave the open furrow wider at the bottom will evidently give considerably better coverage, but probably would not be so well suited to the plowing of all types of ground as the general-purpose bottoms now commonly used.

Experiments by Young, Shawl, and E. W. Lehmann on the mechanical harvesting of corn and small grains showed that for all crops the threshing loss was higher for combines than for stationary threshers. Of the total loss, that left by the cutter bar was largest. The shock loss was highest in the threshing of wheat, indicating that particular care should be used in cleaning up around the shocks. Tests on samples collected in oats fields indicated that the interval between time for binding and time for combining is considerably less than that for wheat, probably not more than 5 or 6 days.

Nine tests of corn harvesting losses were made in machine-picked fields and 7 in hand-picked fields. In the machine-picked fields the total loss varied from 24.8 to 2 per cent, with an average of 10.2 per cent. The ear loss varied from 14.7 to 1.1 per cent, with an average of 6.6 per cent, or 65 per cent of the total loss. The shelled corn loss varied from 10.1 to 0.9 per cent, with an average of 3.6 per cent, or 35 per cent of the total loss. The ear loss increased as the stalks and shanks became drier, and the shelled corn loss increased as the ears dried out. In the hand-picked fields the amount left in the field varied from 7.3 to 3.6 per cent, with an average of 5 per cent.

New tests on equipment for artificially drying grain and on stationary spray plants are also described.

Book Review

"The Introduction of Farm Machinery in Its Relation to the Productivity of Labor in the Agriculture of the United States During the Nineteenth Century," by Leo Rogin, is Volume 9 of University of California Publications in Economics. It is divided into two parts, namely I. The Plow (with some consideration of other tillage machinery) and II. Wheat Production. Paper bound, illustrated, 260 pages, 10¼ x 6⅞ inches. $3.50.

"New Departure Ball Bearings" has recently been published in the eighth edition. It is a manufacturer's handbook of particular interest to designing engineers. An index page shows the types of bearings available and their general characteristics, and provides ready reference to the sizes, dimensions, and capacities at various speeds for each type. There are also, as previously, sections on "Selection of Bearing Size," "Bearing Mounting Information," "Equivalent Ball Bearing Sizes," and "Bearing Weights—Conversion Tables," to help the designer select bearings which most nearly meet his requirements. Any designer may obtain a copy free by writing to the New Departure Manufacturing Company, Bristol, Connecticut.

AGRICULTURAL ENGINEERING

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Contributions of interest and value, especially on new developments in the field of agricultural engineering, are invited for publication in this journal. Its columns are open for discussions on all phases of agricultural engineering. Communications on subjects of timely interest to agricultural engineers, or comments on the contents of this journal or the activities of the Society, are also welcome.

Original articles, papers, discussions, and reports may be reprinted from this publication, provided proper credit is given.

Raymond Olney, Editor

R. A. Palmer, Associate Editor

Too Many Acres in the Same Crops

FROM an editorial, entitled "Land Reclamation," which appeared in the Lebanon (Pa.) News and is reprinted in the September 1931 issue of "New Reclamation Era" we quote:

"America's land problem is not that there are too many acres under cultivation, but that too many acres are planted in the same crops and too much poor land is producing poor crops when there are unclaimed acres which, through irrigation, could be made to produce better crops at less cost."

That is interesting as a well-founded but unorthodox eastern viewpoint on western irrigation. But its implications apply to agricultural engineering in the broadest sense. It suggests that with the increased physical control over the conditions of nature now possible through engineering, American agriculture should not limit itself by the precedents set by its pioneer founders whose control over nature was necessarily limited.

America's pioneer white settlers were barely able to provide for their food and clothing needs by raising the crops and livestock of their forefathers and of the Indians, which they found would return most with the least effort.

These staples have been improved by breeding. Their methods of production have had the benefit of research. Ways and means of controlling their diseases and pests have been developed. Related commerce and industries have grown up around these commodities. Agriculture has concentrated on their production until the accusation "too many acres in the same crops" is true.

Agriculture and many of the other industries are learning together in the dear school of experience that peoples' wants are unlimited, not in the direction of infinite quantity, but in the direction of infinite variety.

It will take time to expand the variety of wants which can be satisfied through agriculture, but it can be done. Further lowering of the cost of production will increase the availability of staples as industrial raw materials and chemical engineering research will greatly increase their usefulness as such.

Certain crops and livestock have remained specialties because nature has provided few places suitable for their production. Serious study of the favorable conditions will result in their being economically duplicated by man with resulting shift of some of agriculture's production capacity from the surplus staples into these specialties. Likewise there are crops and animals of other countries which it might be profitable to raise in parts of this country with the control of physical conditions now possible. And, to carry the imagination even further, it seems improbable that the comparatively few plants and animals which men, following the course of least resistance, have domesticated, are the only ones capable of economically producing useful commodities under the guidance of farmers with such control devices as agricultural engineers might create for them. With the assurance of engineers providing any physical conditions required, economic biologists might undertake the domestication and genetic improvement of the more promising of thousands of species of plant and animal life which are still in a state of natural development.

Agricultural engineers stand ready to provide the control means to help agriculture get away from the stigma of "too many acres planted in the same crops."

A New Meetings Feature

AT THE meeting of the North Atlantic Section of the American Society of Agricultural Engineers this month the program for one evening will segregate the assembled agricultural engineers into small groups for organized discussion, under definite leadership, on prearranged subjects.

There is nothing new in small groups gathering at A.S.A.E. meetings and informally discussing anything and everything within the field of agricultural engineering far into the night. But putting this discussion on an organized basis is new—except in the North Atlantic Section—and has apparent advantages. It leaves no doubt in the mind of anyone as to when and where to go to get into a discussion which will be of interest to him. Having a definitely assigned leader helps to get the discussion started off on the right foot, to hold it to the subject and to give everyone a chance to add his bit.

These discussions will reverberate beyond the walls of the Woodrow Wilson Hotel in New Brunswick. They may be so successful that similar "round tables" will be arranged at some of the Society's future technical division meetings. Certainly they will cover more ground and uncover more new ideas and information than would otherwise be possible in a two and one-half day section meeting.

No program of papers and addresses arranged by a committee can possibly provide enough time for discussion, or otherwise equal the ability of a number of small, well-organized discussion groups to reflect the trend of interest and thought of a technical group such as the American Society of Agricultural Engineers.

Agricultural Engineering in France

THE varied reactions of the American public to necessary changes in and the increased application of engineering to agriculture, with accompanying growth of the farm equipment industry, are paralleled in France, where they have been expressed with the emotion characteristic of the nationality. From the British "Implement and Machinery Review" we re-quote two widely divergent views.

To one French scribe "It is a guarantee of our independence and an important element of the economic prosperity of our agriculture and of our entire country."

But here is the characteristic, supposedly aesthetic, viewpoint, " . . . . it does not even respect the picturesque scenes that poetry and painting have popularized." We say "supposedly aesthetic" because in our philosophy the engineer's dynamic wrestling with reality, however disrespectful of tradition, is more truly aesthetic than painting and poetry when these arts express nothing higher than the static idealism of inadaptable individuals who ride backwards through life, seeing beauty only from a distance as it recedes into the past.

A.S.A.E. and Related Activities

PROGRAM
NORTH ATLANTIC SECTION MEETING

Woodrow Wilson Hotel
New Brunswick, N. J.
October 15, 16 and 17, 1931

Thursday, October 15

Forenoon—9:30 to 12:00

1. Opening Address of the Chairman—L. S. Caple, rural service engineer, Rochester Gas & Electric Corporation
2. Effects of Dairy Barn Temperature and Humidity on Milk Yields — C. B. Bender, associate professor of dairy husbandry, Rutgers University
3. Electric Ventilation of Farm Structures—J. L. Strahan, consulting agricultural engineer

Afternoon—2:00 to 4:30

1. ADDRESS of Welcome—Hon. John J. Morrison, mayor, New Brunswick
2. New Developments in Feed-Processing Machinery—F. J. Bullock, experimental engineer, Papec Machine Company
3. Address by F. G. Helyar, director of resident instruction, agricultural college, Rutgers University
4. The Development of an Electric Dairy Utensil Sterilizer — H. E. Besley, department of agricultural engineering, University of Maryland

Evening—7:30 to 10:00

1. RURAL ELECTRIFICATION ROUND TABLES
   (a) "Burglar Alarms" (Led by J. R. Haswell, Pennsylvania State College)
   (b) "Orchard Insect Control" (Led by L. S. Caple, Rochester Gas & Electric Corp.)
   (c) "Electricity in Poultry Production" (Led by N. D. Herrick, Boston Edison Co.)
   (d) "Power Consumption Records on Farm Equipment" (Led by Ray W. Carpenter, University of Maryland)
   (e) "Correlation of Research and Extension Work" (Led by B. B. Robb, Cornell University)
2. FARM STRUCTURES ROUND TABLES (Program not yet completed)
3. FARM MACHINERY ROUND TABLES
   (a) "Potato Harvesting Machinery" (Led by R. U. Blasingame, Pennsylvania State College)
   (b) "Hay Drying" (Led by A. W. Clyde, Pennsylvania State College)

Friday, October 16

Forenoon—9:30 to 12:00

1. Preservative Treatments for Exterior Metal Surfaces—S. A. Knisely, director of research, National Association of Flat Rolled Steel Manufacturers
2. Stationary Spray Plants—C. A. Arneson, Friend Manufacturing Company
3. Disposal of Creamery Wastes—C. R. Cox, New York State Department of Health

Afternoon—2:00 to 4:30

1. Conditions Affecting the Development of Fertilizer Distributing Machinery — G. A. Cumings, agricultural engineer, U. S. Department of Agriculture
2. Progress in Rural Electrification on the Pacific Coast—G. W. Kable, director, National Rural Electric Project
3. Gasoline Engine Detonation — Its Cause and Control—C. G. Krieger, Jr., agricultural engineer, Ethyl Gasoline Corporation
4. Business Meeting

Evening—7:00

1. Annual Section Dinner

Saturday, October 17

Forenoon—9:30 to 12:00

1. Agricultural Engineering in Vocational High Schools—E. V. Bearer, associate professor of agricultural education, Rutgers University
2. Hot Beds, Cold Frames and Propagating Benches—G. A. Rietz, in charge of rural electrification section, General Electric Company
3. Irrigation Development in the Eastern States—C. E. Seitz, professor of agricultural engineering, Virginia Polytechnic Institute

New Digest of Current Agricultural Engineering Literature

THE U.S.D.A. Bureau of Agricultural Engineering, published in August Volume 1, Number 1 of "Agricultural Engineering Current Literature," a mimeographed bulletin of abstracts of recently published agricultural engineering literature coming to the attention of the Bureau. Emphasis is placed on articles reporting results of research.

This bulletin of abstracts will be published monthly, and persons wishing to receive it regularly may request the Bureau to add their names to the mailing list.

German Engineers Visit ASAE Headquarters

DR. C. H. Th. DENCKER, director of the department of agricultural engineering, Prussian Agricultural Research Institute, and Dr. Nordahl Wallem, German agricultural engineer, who has been conducting research work in agricultural economics with Prof. M. L. Wilson at Montana State College, visited ASAE headquarters September 1. Dr. Dencker is active in the German Society of Agricultural Engineers, holding the office of vice-president, and was interested in learning something of the ASAE headquarters work.

For lunch and during the afternoon they were guests of ASAE members J. C. Bohmker and Dent Parrett, who showed them the construction and operating features of a new general-purpose farm tractor.

N.A.F.E.M. Announces Annual Convention

THE National Association of Farm Equipment Manufacturers will hold its thirty-eighth annual convention at the Congress Hotel, Chicago, Illinois, October 21, 22 and 23.

TENTATIVE PROGRAM
THIRD ANNUAL "DAIRY ENGINEERS' INSTITUTE"

SPONSORED BY THE A.S.A.E. COMMITTEE ON DAIRY ENGINEERING

Auditorium, Atlantic City, N. J.
October 29, 1931

Forenoon—9:30 to 12:00

1. Address of Welcome—H. H. Miller, president, Dairy and Ice Cream Machinery and Supplies Association
2. Relation of Physical and Chemical Properties of Dairy Products to Equipment Design—Dr. A. C. Dahlberg, chief in dairying research, New York Agricultural Experiment Station
   Discussion led by O. F. Hunziker, director of research, Blue Valley Creamery Company
3. SYMPOSIUM "Stainless Steels"
   (a) Properties and Fabrication of Stainless Steel—L. W. Hostettler, Allegheny Steel Company
   (b) Dairy and Other Industrial Uses of Stainless Steel—C. M. Snyder, Metallurgist, Republic Steel Company
4. SYMPOSIUM "Weighing"
   (a) New Developments in Weighing Equipment for the Dairy Industry —H. C. Whitehorne, technical engineer, Toledo Scale Company
   (b) New Developments in Weighing Machinery for the Receiving Room —Geo. W. Head, technical engineer, Burroughs Adding Machine Company
5. What We Should Learn from the Depression—Gus W. Dyer, editor "Southern Agriculturist," professor of economics, Vanderbilt University

Afternoon—2:00 to 4:30

1. ADDRESS—L. J. Fletcher, president, American Society of Agricultural Engineers
2. Plant Economies Through an Adequate Conveying System—W. A. Baril, plant and production manager, Borden Farm Products Company
   Discussion led by Ralph Kopp, Pevely Dairy, and Ben Cabell, Southwest Dairy Products Corporation
3. The Factory Method of Milk Production—H. W. Jeffers, manager, Walker-Gordon Company
   Discussion led by R. R. Graves, Bureau of Dairy Industry, U. S. Department of Agriculture, and Ralph Stoddard, De Laval Separator Company
4. SYMPOSIUM "Quick Hardening of Ice Cream"
   (a) Its Advantages and Disadvantages —Dr. A. H. Bayer, director of research and production, General Ice Cream Co.
   (b) Informal discussions led by C. P. Dampier, Borden Company, and Dr. J. P. Buckley, Supplee-Wills-Jones Company
5. Providing Sanitary Refrigeration for the Dairy with Cold Diffusion—W. B. Rorison, Carrier Engineering Company
6. Plant Research Studies of Ice Cream Equipment—Wilbur A. Thomas, production manager, Hages Ice Cream Company
7. BUSINESS SESSION

ASAE Meetings

North Atlantic Section—at Rutgers University, New Brunswick, New Jersey, Thursday and Friday, October 15 and 16.

Power and Machinery Division — at the Stevens Hotel, Chicago, Ill., Monday and Tuesday, November 30 and December 1.

Structures Division—at the Stevens Hotel, Chicago, Ill., Tuesday and Wednesday, December 1 and 2.

Reclamation Division — at the Stevens Hotel, Chicago, Ill., Wednesday and Thursday, December 2 and 3 (Tentative).

Southern Section — at Birmingham, Alabama, February 3, 4 and 5, 1932.

American Engineering Council

THE fall meeting of the Administrative Board of American Engineering Council is scheduled to be held Friday and Saturday, October 30 and 31, 1931, at the Mayflower Hotel, Washington, D. C. Dates for the annual meeting of Council have been fixed for January 14, 15 and 16, 1932.

Negotiations are under way between the United States and Canada on the St. Lawrence Waterway Project, in which Council is interested. President Hoover placed the United States on record months ago as ready to negotiate. News dispatches indicate that Canada also is now ready to proceed. It is expected that a treaty will be prepared by Hanford J. MacNider, U. S. Minister to Canada, and Wm. D. Herridge, Canadian Foreign Minister, for ratification by their respective governments.

Council last winter divided the unemployment problem into the two phases of immediate relief and permanent elimination or alleviation of the cause. Separate committees were appointed to study each phase of the problem. One is known as the Committee on Relief from Unemployment. The other is the Committee on Relation of Production, Distribution and Consumption.

Federal attention to the problem has been divided along the same lines. Immediate relief is in charge of the President's Organization on Unemployment Relief. Dr. C. E. Grunsky, President of American Engineering Council, is a member of the advisory committee. Alleviation of the cause is to be studied by the Employment Stabilization Board. The U. S. Department of Labor has reorganized the Federal Employment Service and placed a representative in each state. It also has a Committee on Technological Employment, on which Council is represented. Council's Committee on Relief from Unemployment has prepared a plan entitled "Engineers and Employment," which has been presented to member organizations for consideration.

"Who's Who in Engineering," third revised edition, is now ready for distribution. The second edition was published in 1925. The new edition, in 1600 6x9-inch pages, contains biographical data and a geographical index of 12,000 prominent engineers. A committee representing Council prepared the specifications for determining which engineers were eligible for inclusion and actively promoted the submission of names and data on all engineers who might be eligible.

Many of the member societies have endorsed the Temple plan, embodied in the U. S. Department of Interior Appropriation Bill, for speeding up the topographic mapping of the United States. Base maps are still unavailable in many sections of the country where important engineering developments are either in progress or projected. Colonel C. H. Birdseye, former chief topographic engineer of the U. S. Geological Survey, in a letter to Council's executive secretary, has heartily endorsed the plan.

The President's commission on the disposition of Muscle Shoals, including three representatives from each of the States of Alabama and Tennessee, and from the federal government, has visited the properties, made recommendations on its disposal, and secured seven or more bids in accordance with its recommendations.

Personals of ASAE Members

Ralph R. Parks, instructor in agricultural engineering, University of Missouri, is author of Missouri Agricultural Experiment Station Bulletin 304, entitled "Electric Hotbeds."

C. E. Ramser, senior drainage engineer, U.S.D.A. Bureau of Agricultural Engineering, is author of "Farm Terracing," which is published as U.S.D.A. Farmers' Bulletin 1669.

Frank J. Zink, associate professor of agricultural engineering, Kansas State College, is author of Kansas Agricultural Extension Bulletin 69, entitled "Electric Motors for the Farm."

New ASAE Members

Charles A. Matthews, field representative, American Zinc Institute, Windom, Minn.

Robert Millinchamp, assistant in agricultural engineering, Macdonald College of McGill University, Macdonald College, P. Q., Canada.

Charles E. Watson, salesman, Aluminum Company of America, Kansas City, Mo.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the September issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Carl A. Arneson, assistant sales manager, Delaware Friend Corporation, Gasport, N. Y.

Hugh A. Brown, director of reclamation economics, Bureau of Reclamation, Department of the Interior, Washington, D. C.

John R. Carreker, rural electrification sales, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Orval C. French, junior agricultural engineer, University of California, Davis, Calif.

Edwin H. Sudduth, Jr., engineer and assistant to the president, W. B. Swain, Inc., Hollyknowe, Miss.

Clesson N. Turner, extension agricultural engineer, University of Maine, Orono, Maine.

Francis D. Yung, assistant to research engineer, University of Nebraska, Lincoln, Nebr.

EMPLOYMENT BULLETIN

An employment service is conducted by the American Society of Agricultural Engineers for the special benefit of its members. Only Society members in good standing are privileged to insert notices in the "Men Available" section of this bulletin, and to apply for positions advertised in the "Positions Open" section. Non-members as well as members, seeking men to fill positions, for which members of the Society would be logical candidates, are privileged to insert notices in the "Positions Open" section and to be referred to persons listed in the "Men Available" section. Notices in both the "Men Available" and "Positions Open" sections will be inserted for one month only and will thereafter be discontinued, unless additional insertions are requested. Copy for notices must be received at the headquarters of the Society not later than the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. There is no charge for this service.

Men Available

AGRICULTURAL ENGINEER desires position in college or research work, has master's degree from Texas A. & M. College, 1929, two years' experience as farm manager on development project. Age 26. Married. MA-202.

MECHANICAL ENGINEER, experienced in sale of parts and accessories to tractor, farm machinery and industrial manufacturers, seeks a new connection. MA-203.

AGRICULTURAL ENGINEER with bachelor's and master's degrees from Cornell University, thirteen years' teaching and extension experience in land grant colleges, together with six years' design and promotion work with manufacturer of stable equipment, desires resident teaching or extension work in agricultural engineering, preferably farm structures and drainage. Prefers eastern location but will go anywhere. Married. MA-204.